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PROFESSOR HELMHOLTZ.

THE Society of Telegraph Engineers and of Electricians, by its *conversazione* held on the 11th inst. at University College, has paid a graceful tribute to one of the most distinguished physicists of the present century, and at the same time has given a striking proof of its desire to be no longer considered as a Society exclusively devoted to Telegraphy.

The new title adopted by the Society, although rendered necessary by its determination to lengthen its cords and strengthen its stakes, was hardly a sufficient inauguration of the change, but the step it has taken has certainly supplied this omission.

If the Society were purely telegraphic, the reception given to Professor Helmholtz would be meaningless, as the great physicist has not directly identified himself with telegraphic science; as an electrical society, however, it has done well in giving honour to the distinguished physicist, and is likely to bring itself into prominence by doing so.

Professor Herrman Ludwig Ferdinand Helmholtz, one of the most distinguished natural philosophers and physiologists of the present century, was born at Potsdam, in August, 1821. After obtaining his degree as Doctor of Medicine he served for a time as a military surgeon, and became, in 1849, Extra-ordinary Professor, and in 1852, Ordinary Professor of Physiology in the University of Königsberg; in 1855 he become Professor of Physiology in the University of Bonn, and in 1858, Professor of Physiology in that of Heidelberg. Between 1847 and 1854 he published a most remarkable and original series of papers on the relation amongst the physical forces, in which he laid the foundation of that branch of the general theory of physical energy which shows how electricity and magnetism as well as heat and motion can be brought under that theory. In 1852 he contrived a new method of experimenting on the combination of the colours of the spectrum, by which all the possible combinations of those colours in pairs were exhibited, and various unexpected facts and laws were discovered. He has also investigated experimentally the velocity with which sensation and volition are transmitted by the nerves of different animals, the laws of the sensibility of the retina, the development of heat and waste of substance by muscular action, and the mode of vibration of the strings of violins and other musical instruments, making in each case most interesting and valuable additions to our knowledge. The whole of the researches of Professor Helmholtz are marked by rare exactness and care in the observation of details combined with still more rare comprehensiveness and soundness of generalisation, as is evidenced in his "Popular Lectures on Scientific Subjects," which, thanks to Professor Tyndall, have been admirably translated by Dr. Atkinson; by his great work on "The Sensation of Tone as a Physiological Basis for the Theory of Music," translated by Mr. Alexander J. Ellis, F.R.S., and by his essay entitled "Die Erhaltung der Krafte" (the conservation of energy) communicated to the Physical Society of Berlin in 1847, and which brought forth the remark of Dr. Du Bois Raymond, "that it was the production of the first head in Europe since the death of Jacobi."

MOLECULAR ELECTRO-MAGNETIC INDUCTION.

By PROFESSOR D. E. HUGHES, F.R.S.

(Read before the Royal Society, March 17th, 1881.)

(Continued from page 122.)

THE following table shows the influence of a permanent twist, and that the current obtained when the wire was freed from its elastic torsion was in opposition to that which should have been produced by the permanent twist. Thus, a well-softened iron wire, 1 millim. in diameter, giving 60° positive current for a right-handed elastic torsion of 20°, gave after 1°·80 permanent torsion a negative current of 10°.

1	complete	permanent	torsion (right-handed)	negative, 10
2	,,	,,	,,	15
3	,,	,,	,,	15
4	,,	,,	,,	16
5	,,	,,	,,	12
6	,,	,,	,,	10
7	,,	,,	,,	5
8	,,	,,	,,	4
9	,,	,,	,,	3
10	,,	,,	,,	3

At this point the fibres of a soft wire commence to separate, and we have no longer a complete single wire, but a helix of separate wires upon a central structure.

If now, instead of passing the current through the coil, I pass it through the wire, and place the telephone upon the coil circuit, I find that I obtain equally as strong tertiary currents upon the coil as in the previous case, although in the first case there was produced longitudinal electro-magnetism in the perpendicular wire by the action of the coil, but in the latter case

none or the most feeble electro-magnetism was produced; yet in these two distinct cases we have a powerful current produced not only upon its own wire, but upon the coil, thus proving that the effects are equally produced both on the wire and coil.

If we desire, however, in these reversible effects to produce in both cases the same electromotive force, we must remember that the tertiary current when reacting upon its own short wire produces a current of great quantity, the coil one of comparative higher intensity. We can, however, easily convert the great quantity of the wire into one of higher tension by passing it through the primary of a small induction coil whose resistance is not greater than one ohm. We can then join our telephone, which may be then one of a high resistance, to the secondary of this induction coil, and by this means, and without changing the resistance of the telephone, receive the same amount of force, either from the iron wire or the coil.

Finding that iron, steel, and all magnetic metals produce a current by a slight twist, if now we replace this wire by one of copper or non-magnetic metals we have no current whatever by an elastic twist, and no effects, except when the wire itself is twisted spirally in helix, and whatever current we may obtain from copper, &c., no matter if from its being in spiral or from not being perpendicular to the axis of the coils, the currents obtained will be invariably secondary and not tertiary. If we replace the copper by an iron wire, and give it a certain fixed torsion, not passing its limit of elasticity, we find that no increase or decrease takes place by long action or time of being under strain. Thus a wire which gave a sonometric force of 50° at the first observation remained perfectly constant for several days until it was again brought to zero by taking off the strain it had received. Thus we may consider that as long as the wire preserves its elasticity, exactly in the same ratio will it preserve the molecular character of its magnetism.

It is not necessary to use a wire to produce these effects; still more powerful currents are generated in bars, ribbons, or sheets of iron; thus, no matter what external form it may possess, it still produces all the effects I have described.

It requires a great many permanent twists in a wire to be able to see any effect from these twists, but if we give to a wire, 1 millim. diameter, forty whole turns (or until its fibres become separated) we find some new effects; we find a small current of 10° in the same direction as it molar twist, and on giving a slight twist (20°) the sonometric value of the sound obtained is 80°, instead of 50°, the real value of a similar untwisted wire; but its explanation will be found by twisting the wire in a contrary direction to its molar twist. We can now approach the zero but never produce a current in the contrary direction, owing to the fact that by the spiral direction, due to the fibrous molar turns, the neutral position of its molecules are no longer parallel with its wire, but parallel with its molar twist, consequently an elastic strain in the latter case can only bring the molecules parallel with its wire, producing no current, and in the first case the angle at which the reaction takes place is greater than before, consequently the increased value of its current.

The measurements of electric force mentioned in this paper are all sonometric on an arbitrary scale. Their absolute value has not yet been obtained, as we do not, at our present stage, require any except comparative measures.* Thus, if each wire is of 1 millim. diameter and 20 centims. long, all render the same stress in the axis of its coil. I find that the following are the sonometric degrees of value:—

	°	
Soft iron	60	Tertiary current.
Hard drum iron	50	" "
Soft steel	45	" "
Hard tempered steel ...	10	" "
Copper, silver, &c. ...	—0	" "
Copper helix, 1 centim. diameter, 20 turns in 20 centims.	45	Secondary currents.
Iron, spiral, ditto ...	45	" "
Steel	45	" "

The tertiary current increases with the diameter of the wire, the ratio of which has not yet been determined; thus an ordinary hard iron wire of 1 millim. diameter, giving 50°, one of 2 millims. diameter gave 100°; and the maximum of force obtained by any degree of torsion is at or near its limit of elasticity, as if in same time we also pass this point, producing a permanent twist the current decreases, as I have already shown in the case of a permanent twist. Thus, the critical point of 1 millim. hard iron wire was 20° of torsion, but in hard steel it was 45°.

Longitudinal strains do not produce any current whatever, but a very slight twist to a wire under a longitudinal strain produces its maximum effects: thus, 20° of torsion being the critical point of iron wire, the same wire, under longitudinal strain, required but from 10° to 15°. It is very difficult, however, to produce a perfect longitudinal strain alone. I have, therefore, only been able to try the effect of longitudinal strain on fine wires, not larger than 1 millim. in diameter, but as in all cases, no effect whatever was produced by longitudinal strain alone, I believe none will be found if absolutely free from torsion. The molecules in a longitudinal strain are equally under an elastic strain as in torsion, but the path of their motion is now parallel with its wire, or the zero of electric inductive effect, but the compound strain composed of longitudinal and transverse, react upon each other, producing the increased effect due to the compound strain.

The sonometer is not only useful for showing the direction of the current and measuring it by the zero method, but it also shows at once if the current measured is secondary or tertiary. If the current is secondary its period of action coincides with that of the sonometer, and a perfect balance, or zero of sound, is at once obtained, and its value in sonometric degrees given, but if the current is tertiary, no zero is possible, and if the value of the tertiary is 60°, we find 60° the nearest approach to zero possible. But by the aid of separate induction coils to convert the secondary into a tertiary, a perfect zero can be obtained if the time of action and its force correspond to that which we wish to measure.

If I place a copper wire in the balance and turn the coils at an angle of 45°, I obtain a current which the sonometer gives a perfect zero at 50°, proving, as already said, that it is secondary. If I now replace the copper by an iron wire, the coil remaining at 45°, I have again exactly the same value for the iron as copper, viz., 50°, and in both cases secondary. Now, it is evident that in the case of the iron wire there was produced at each passage of the current a strong electro-magnet, but this longitudinal magnetism did not either change the character of the current or its value in force.

A most beautiful demonstration of the fact that longitudinal magnetism produces no current, but that molecular magnetism can act equally as well, no matter

* 50° sonometer has the same electromotive force as 0° 10 of a Daniell battery.

the direction of the longitudinal magnetism, consists in forming an iron wire in a loop, or taking two parallel but separate wires, joined electrically at their fixed ends, the free ends being each connected with the circuit, so that the current generated must pass up one wire and down the adjacent one. On testing this loop, and if there are no internal strains, complete silence or absence of current will be found. Now, giving a slight torsion to one of these wires in a given direction, we find, say, 50° positive; twisting the parallel wire in a similar direction produces a perfect zero, thus, the current of the second must have balanced the positive of the first. If, instead of twisting it in similar directions, we twist it in the contrary direction, the sounds are increased in value from 50° positive to 100° positive, showing, in this latter case, not only a twofold increase of force, but that the currents in the iron wires travelled up one wire and down the other, notwithstanding that both were strongly magnetic by the influence of the coil in one direction, and this experiment also proves that its molar magnetism had no effect, as the currents are equally strong in both directions, and both wires can double or efface the currents produced in each. If instead of two wires we take four, we can produce a zero, or a current of 200°, and with twenty wires we have a force of 1,000°, or an electromotive force of two volts. We have here a means of multiplying the effects by giving an elastic torsion to each separate wire, and joining them electrically in tension. If loops are formed of one iron and one copper wire, we can obtain both currents from the iron wire, positive and negative, but none from the copper, its *rôle* is simply that of a conductor upon which torsion has no effect.

I have already mentioned that internal strains will give out tertiary currents, without any external elastic strain being put on. In the case of iron wire, these disappear by a few twists in both directions, but in flat bars or forged iron they are more permanent; evidently, portions of these bars have an elastic strain, whilst other portions are free, for I find a difference at every inch tested: the instrument, however, is so admirably sensitive, and able to point out not only the strain, but its direction, that I have no doubt its application to large forged pieces, such as shafts or cannon, would bring out most interesting results, besides its practical utility; great care is therefore necessary in these experiments that we have a wire free from internal strains, or that we know their value.

Magnetising the iron wire by a large steel permanent magnet has no effect whatever. A hard steel wire thus placed becomes strongly magnetic, but no current is generated, nor has it any influence upon the results obtained from molecular movement, as in elastic torsion. A flat wide iron or steel bar shows this better than iron wire, as we can here produce transversal, instead of longitudinal, but neither shows any trace of the currents produced by molecular magnetism. I have made many experiments with wires and bars thus magnetised, but as the effect in every case was negative when freed from experimental errors, I will not mention them; but there is one very interesting proof which the instrument gives, that longitudinal magnetism first passes through its molecular condition before and during the discharge, or recomposition of its magnetism. For this purpose, using no battery, I join the rheotome and telephone to the coil, the wire having no exterior circuit. If I strongly magnetise the two ends of the wire, I find by rapidly moving the coil that there is a Faradaic induction of 50° at both poles, but very little or none at the centre of the wire; now fixing the coil at the centre or neutral point of the wire, and listening intently, no sounds are heard, but the instant I give a slight elastic torsion to the free pole, a rush of electric tertiary induction is heard, whose value is 40°. Again, testing this wire by moving the coil, I find only a remaining magnetism of 10, and upon repeating the experiment of elastic torsion, I find a tertiary of 5; thus we can go on gradually discharging the wire, but its discharge will be found to be a recomposition, and that it first passed through the stage I have mentioned.

Heat has a very great effect upon molecular magnetic effects. On iron it increases the current, but in steel the current is diminished. For experimenting on iron wire, which gave a tertiary current of 50° positive (with a torsion of 20°), upon the application of the flame of a spirit-lamp, the force rapidly increases (care being taken not to approach red heat), until the force is doubled, or 100 positive. The same effects were obtained in either direction, and were not due to a molar twist or thermo-current, as if care had been taken to put on not more than 10° of torsion, the wire came back to zero at once on removal of the torsion. Hard tempered steel, whose value was 10° whilst cold, with a torsion of 45°, became only 1° when heated, but returned (if not too much heated) to 8° when cold. I very much doubted this experiment at first, but on repeating the experiment with steel several times, I found that on heating it I had softened the extreme hard (yellow) temper to that of the well-known blue temper. Now, at blue temper, hot, the value of steel was but 1° to 2°, whilst soft iron of a similar size gave 50° of force cold, and 100° at red heat. Now, as I have already shown that the effects I have described depend on molecular elasticity, it proves at least, as far as iron and steel are concerned, that a comparatively perfect elastic body, such as tempered steel, has but slight molecular elasticity, and that heat reduces it, but that soft iron, having but little molar elasticity, has a molecular elasticity of a very high degree, which is increased by heat.

The objects of the present paper being to bring the experimental facts before the notice of the Royal Society, and not to give a theoretical solution of the phenomena, I will simply add, that if we assume with Poisson, that the paths of the molecules of iron are circles, and that they become ellipses by compression or strain, and also that they are capable of being polarised, it would sufficiently explain the new effects.

Joule has shown that an iron bar is longer and narrower during magnetisation than before, and in the case of the transverse strain, the exterior portions of the wire are under a far greater strain than those near the centre, and as the polarised ellipses are at an angle with the molecules of the central portions of the wire. its polarisation reacts upon them, producing the comparatively strong electric currents I have described.

PERMANENT MOLECULAR TORSION OF CONDUCTING WIRES PRODUCED BY THE PASSAGE OF AN ELECTRIC CURRENT.

By PROFESSOR D. E. HUGHES, F.R.S.

(Read before the Royal Society March 31st.)

IN a paper on "Molecular Electro-Magnetic Induction," presented to the Royal Society March 7, 1881, I gave a description of the induction currents produced by the torsion of an iron wire, and the method by which they are rendered evident. The electro-magnetic induction

balance there described is so remarkably sensitive to the slightest internal strain in anywise submitted to it, that I at once perceived that the instrument could not only determine any mechanical strain such as torsion or longitudinal stress, but that it might indicate the nature and cause of internal strains. Upon putting the question to it, does the passage of electricity through a wire produce a change in its structure? the answer came, it does, and that to a very considerable extent; for an iron wire adjusted to perfect zero, and which would remain free from any strain for days, becomes instantaneously changed by the first passage of a current from a single cell of Daniell's battery; the wire has now a permanent twist in a direction coinciding with that of the current, which can be brought again to zero by mechanically untwisting the wire, or undoing that which the passage of electricity has caused. Before describing the new phenomenon, I will state that the only modificatiom required in the apparatus, is a switch or key by means of which the telephone upon the wire circuit is thrown out of this circuit, and the current from a separate battery of two bichromate cells passed through the wire alone, at the same time, care being taken that no current passes through the coil, but that its circuit should remain open during the passage of the electric current through the wire under observation; an extra switch on this circuit provides for this. The reason for not allowing two currents to react upon each other, is to avoid errors of observation which may be due to this cause alone. When, however, we take an observation, the battery is upon the coil and the telephone upon the wire alone; an experiment thus consists of two operations. First, all external communications interrupted, and an electric current passed through the wire; and, second, the electric current taken off the wire, and all ordinary communications restored. As this is done rapidly by means of the switches, very quick observations can be made, or if desired the effects of both currents can be observed at the same instant.

Now, if I place upon the stress bridge a soft iron wire ½ millim. diameter, 25 centims. long, I find, if no previous strain existed in the wire, a perfect zero, and I can make it so either by turning it slightly backwards or forwards, or by heating the wire to a red heat. If I now give a torsion of this wire, I find that its maximum value is with 40° torsion, and that this torsion represents or produces electric currents whose value in sonometric degrees is 50; each degree of torsion up to 40 produces a regular increase, so that once knowing the value of any wire, we can predict from any sonometric readings the value in torsion, or the amount of torsion in the opposite direction it would require to produce a perfect zero.

If now I place this wire at zero, and thus knowing that it is entirely free from strain, I pass an electric current through it, I find that this wire is no longer free from strain, that it now gives out induction currents of the value of 40, and although there is no longer any battery current passing through this wire that the strain is permanent, the outside coil neither increasing or diminishing the internal strain it has received by the passage of an electric current through the wire; upon giving a torsion to the wire in one direction I find the inductive force increase from 40 to 90, but in the other direction it is brought to zero, and the amount of torsion, some 35°, required to bring the wire again to zero represents exactly the twist or strain that had been produced instantaneously by the passage of an electric current. If I repeat the experiment, but reverse the battery current sent through the wire, I find that an opposite twist of exactly the same value as previously, and that it now requires an opposite torsion to again bring the wire to zero. It is not necessary, however, to put on an equal opposite torsion on wire to bring the currents to zero, for, as I have shown in my late paper, the sonometer not only allows us to measure the force and indicate its direction, but allows us to oppose an equal electric current of opposite name, thus producing an electrical zero in place of the mechanical one produced by torsion.

Evidently here there has been a sudden change in the structure of the wire, and it is a twist which we can both measure and reproduce. The question at once becomes, has a molar twist been given to the wire such as would be detected by the arm or free end of the wire, or a molecular change leaving no trace upon its external form of what has passed?

It will be found that, notwithstanding that it requires some 40° of torsion to annul the effects of a passage of an electric current, no visible movement nor any tendency of the free end to turn in the direction of the twist it has received can be observed. I believe, however, to have noticed a slight tremor or movement of half a degree, but as I could not always reproduce it, and as it is so slight compared with the 40° of internal twist, I have not taken it into account, for if the wire is firmly fastened at both ends, no molar torsion being possible, except an elastic one, which would instantly spring back to zero, the current on passing produces its full effects of twist and it is permanent. Thus, the molecules have in some extraordinary way re-arranged themselves into a permanent twist, without the slightest external indication of so great a change having taken place. An equally remarkable change takes place in aid of, or against (according to direction of current) an elastic permanent strain. Thus, if I first put the wire under 40° right-handed permanent torsion, I find its value to be 50. Now, passing the positive of battery through its free end, and negative to fixed end, the induction currents rise at once in value to 90; if, now, the negative is momentarily passed through the free end and positive to fixed end the induced currents at once fall to 10, and these effects remain, for on taking off the elastic torsion the wire no longer comes to zero, but has the full twist value produced by the current.

Tempered steel gave only one or two degrees against 50 for soft iron, but supposing this might be due to its molecular rigidity, I carefully brought the wire to zero, and then observed the first contact only. I found, then, that the first contact gave a value of 40, but the second and following only one or two. By bringing the wire back to zero by a momentary touch with a magnet, a continued force of 40, or if constant reversals were used instead of a simple contact, there was constant proof of a similar great molecular change by the passage of a current in steel as well as iron.

I can find no trace of the reaction of the wire upon the magnetism of the earth, as in all positions the same degree of force was obtained if great care is taken that the wire is absolutely free from longitudinal magnetism; there is, however, a slight reaction upon its own return wire if brought within 1 centim. distance of the wire, and this reduces the twist some 10°. The maximum effects are obtained when the return wire is not nearer than 25 centims.; thus, the action is not one produced by a reaction, but by direct action upon its internal structure.

Copper and silver wires so far show no trace of the action. I believe, however, that a similar strain takes place in all conductors, and I have obtained indirectly indications of this fact; in order, however, to verify this, it would require a different method of observation from the one I have described, and I have not yet perfected the apparatus required.

It seemed probable that if I approached a strong permanent magnet to the wire, I should perceive a twist similar to that produced by the passage of a current; but no such effects were observed, but it has a most remarkable effect of instantly bringing to zero a strain produced by the current, and, no matter which pole, the effect was the same. Thus, a strain of 50°, which remains a constant, instantly disappears upon the production of longitudinal magnetism, and I have found this method of reducing an iron wire to zero of strain far more effective than any other method yet tried, such as vibrations, heat, twisting, &c.

It will be seen from this that the molecular arrangement set up by magnetism is very different from that produced by the passage of an electric current. It evidently has a structure of its own, else it would not have instantly destroyed the spiral strain left by the passage of electricity if it had not taken up a new form, as rendered evident in the longitudinal magnetism, which we could at once perceive on the wire. This question, however, belongs to a separate investigation, and I hope the apparatus will aid me later in throwing some new light upon this subject.

Another method of reducing the wire to zero, after the passage of a current, is to keep the wire in a constant state of vibration. It requires in time about one minute to bring it to zero, but if, on the contrary, I set the wire vibrating during the passage of the current, the permanent twist becomes greater and more difficult to reduce to zero.

If a wire which has internal strains is heated to redness, these strains almost entirely disappear, and I can thus reduce by heat a strain which a current had produced; but heat, whilst allowing of greater freedom and motion of its molecules, does not prevent an internal strain being set up, for whilst heat can reduce the wire to zero, after the passage of the current the effects are increased. If, during the time that the wire is at a red heat, the current is passed in the same time, and at the same instant we take off the current and the external heat, the wire when cold will be found to have a higher degree of strain than previously possible with the wire when cold.

We have seen that both mechanical vibrations and heat can reduce the wire to a zero, but its action is very slow, several minutes being required; but the action of electricity in producing a permanent twist is exceedingly quick. I have found that a single contact, whose duration was not more than 0·01 of a second, was equal to that of a prolonged contact of several minutes, and magnetism was equally as quick in reducing this strain to zero. And it is the more remarkable when we consider the very great mechanical force required by torsion of the wire to untwist the strain produced in an instant of time by electricity.

The results I have given are those obtained upon soft iron wires of ½ millim., but I have experimented with different sizes up to 3 millims. diameter. The results with 1 millim. diameter were quite as evident as the ½ millim., but on the 3 millim. wire the strain was reduced to 25° instead of 50°, owing to the extreme rapidity and low electrical resistance compared with my small battery wires. On a telegraph line, the wire of which is almost entirely of iron, there must be a very great strain set up, which, however, would remain a constant, except where reversed currents are used, and in this case a constant movement of the molecules of the wire must be the result.

I believe it to be most important that we should determine, as far as we can by experimental research, the nature of all molecular changes produced by electricity and magnetism, and in this belief I am happy in being able to bring this paper before the Royal Society.

THE ILLUMINATION OF A CIRCULAR AREA.

By PROFESSOR HOFFMANN.

PROBLEM.—At what height h above the centre of a circular area of radius a must a source of light be fixed in order that

1. The illumination of the circumference
2. That of the whole area

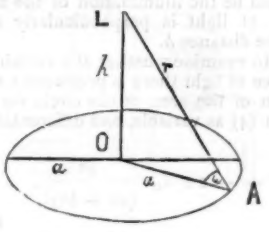
shall be a maximum?

First Solution.—Let the source of light be L, the angle which the ray LA leading to any point of the circumference A forms with the surface of the circle ω and J_0, the quantity of light of the ray at the distance = 1, then the illumination of the point A of the circumference proportional to the incident quantity of light

$$J_A = J_0 \frac{\sin \omega}{r^2}$$

r denoting the distance LA.

For with an equal reflective power of the area and without regarding the absorption of the medium traversed by the light, the illumination is directly as the sine



of the angle at which the ray falls upon the surface, and indirectly as the square of the distance.

For the above expression, putting LO = h, we may write

$$J_A = J_0 \frac{\sin \omega}{r^2} = J_0 \frac{h}{(a^2 + h^2)^{\frac{3}{2}}},$$

and consequently the illumination of the whole circumference of the radius OA = a.

$$(1) \quad J = J_0 \frac{2\pi ah}{(a^2 + h^2)^{\frac{3}{2}}}.$$

By the repeated differentiation of this equation we have

$$(2) \quad \begin{cases} \frac{dJ}{dh} = 2\pi a J_0 \frac{a^2 - 2h^2}{(a^2 + h^2)^{\frac{5}{2}}} \\ \text{and} \\ \frac{d^2J}{dh^2} = 2\pi a J_0 \frac{3h(3a^2 - 2h^2)}{(a^2 + h^2)^{\frac{7}{2}}}. \end{cases}$$

Hence it follows that in the first case a maximum exists, and secondly, since $h = \infty$ that it cannot be utilised. This maximum for which $\frac{dJ}{dh} = 0$ appears

when

$$(3)\quad \begin{cases} a^2 - 2h^2 = 0, \\ h = \frac{a}{2}\sqrt{2} = 0{\cdot}7071\,a. \end{cases} \quad \text{or}$$

The source of light must therefore be fixed at a height approximately equal to 0·7; the radius of the circle and the maximum illumination is $\frac{4\pi J_0 \sqrt{3}}{9a}$.

Second Solution.—In order to find the illumination of the entire circular area at the given distance h from the source of light we must consider an infinitely narrow circular ring of the internal radius y and the breadth dy. Its illumination would be

$$2\pi h J_0 \frac{y\,dy}{(y^2 + h^2)^{\frac{3}{2}}},$$

and in consequence the illumination of the entire area of the circle.

$$(4)\quad J_1 = 2\pi h J_0 \int_0^a \frac{y\,dy}{(y^2 + h^2)^{\frac{3}{2}}}$$
$$= 2\pi J_0 \left\{1 - \frac{h}{(a^2 + h^2)^{\frac{1}{2}}}\right\}.$$

This would be the illumination of the area when the source of light is perpendicularly above its centre at the distance h.

In order to examine whether at a certain distance of the source of light there is produced a maximum illumination of the area of the circle we assume h in equation (4) as variable, and differentiate. This gives

$$(5)\quad \begin{cases} \frac{dJ_1}{dh} = -2\pi J_0 \frac{a^2}{(a^2 + h^2)^{\frac{3}{2}}}, \\ \frac{d^2 J_1}{dh^2} = 6\pi J_0 \frac{a^2 h}{(a^2 + h^2)^{\frac{5}{2}}}. \end{cases} \quad \text{and}$$

There exists therefore in this case no maximum illumination, but a minimum, which is of course reached when $h = \infty$. J_1 is then $= 0$.

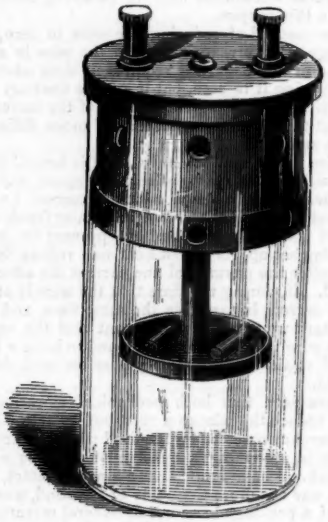
Consequently, and in accordance with equation (4), the illumination of the area of the circle will continually increase as the distance of the source of light diminishes. Still equation (4) must not be interpreted to mean that a maximum illumination is reached when $h = 0$; that is, $J_1 = 2\pi J_0$. This case, as well as $h < 0$ is excluded because for each element of the area the angle of irradiation $\omega = 0$, and consequently as $sin\ 0 = 0$ the incident quantity of light $= 0$.—*Electrotechnische Zeitschrift*, Vol. ii. Part 3.

THE telephonic exchange system in Cleveland, Ohio, and several other places, contemplates a tariff based on single messages, a "message" consisting of a conversation through the exchange occupying five minutes or less time. The charge is ten cents per "message," beside which tickets good for one message each are sold at the rate of 7 dols. for packages of 100.—*The Operator*.

MAICHE'S BATTERY.

THE inventor of this entirely original form of battery, of which we give an illustration, has endeavoured to fulfil all the conditions necessary to make his battery work for an indefinite period, and this ideal result is obtained—thanks to the means of depolarisation which he employs.

A porous vase, pierced with large holes, is fixed to an ebonite cover, which closes an earthenware vase filled with retort carbon, broken in pieces and platinised. The porous vase is traversed by an ebonite tube supporting a small porcelain cup, in which is placed a small quantity of mercury and two small pieces of zinc. A platinum wire, connected to a terminal fixed on the cover, dips into the mercury, and establishes a good contact with the zinc.



Another platinum wire connects a second terminal with the carbon fragments placed in the porous vase. The contacts are thus completely assured. The zinc is not attacked, except when the circuit of the battery is closed; it is plunged entirely in the liquid, consequently it is entirely used up without any loss.

Under the influence of the platinised carbon, the hydrogen of the water, which tends to polarise the carbon, combines with the oxygen of the air. That this novel effect, sought for in vain for a long time, can take place, the carbon should only be partially immersed in the water; the rest becomes wetted by capillary action, and presents a considerable surface to the air.

The water produced by the combination of the hydrogen and the oxygen contributes, to a certain degree, to replace that which passes off by evaporation, and which the cover keeps from being lost.

The electromotive force of this battery is about

1·250 volts.; but it is necessary to work it through an external resistance of about 3 kilometres of ordinary telegraph wire in order that it may work well. The exciting liquid may be water saturated with sal-ammoniac, or acidulated by sulphuric acid, or the bisulphate of soda, in the proportion of 10 to 1.

An element working a bell about 100 times a day would not require to be looked after for a very long time, and, in this case, it would only be the zinc that would require replacing, as the platinised carbon preserves indefinitely its catalytic properties.

The Maiche battery is particularly well adapted for electric bells. Maintenance not being required, its fitness and the care taken in its whole construction, makes it the most perfect bit of apparatus of its kind.—*L'Electricité.*

THE HISSING OF THE VOLTAIC ARC.

By ALFRED NIAUDET.

THE researches of M. Edlund have shown that the voltaic arc has a double resistance, not only an ordinary one as a conductor, but also an active resistance like the polarisation in a voltameter or the electromotive force of the induction of an electro-magnetic motor.

It is extremely difficult to measure the two quantities separately, but, on the contrary, it is easy to measure the *equivalent resistance of the arc*; that is to say, to determine a resistance in ohms which is substituted in the place of the arc and which does not change the strength of the current. On the other hand, thanks to the absolute galvanometer of M. Deprez for measuring electromotive forces, it is very easy to measure the difference of potential between the two carbon electrodes.

The employment of this galvanometer has revealed a curious fact; viz., that the potential is much greater when the arc is silent than when it hisses. The difference is sometimes as much as 10 volts. The needle of the galvanometer can be seen to move sharply and without oscillations from one deflection to the other. If the eye and ear are both kept attentive the noise in the arc can be detected, and a corresponding movement of the galvanometer needle be observed.

The values of the current strengths naturally vary inversely as the potentials of the arc, and if a Deprez galvanometer is placed in the circuit its movements will indicate in webers the value of this element.

The observations which we have made show that the difficulty of measuring the actual resistance of the arc and its electromotive force is much greater than is generally supposed.

THOMAS A. EDISON has removed from Menlo Park to New York with his family and all but one of his assistants, and is now living at No. 65, Fifth Avenue. The offices of the Edison Luminating Company of New York, the Edison Electric Light Company of Great Britain and Europe, and the Edison Electric Railway will also be in the building.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXXI.

THE QUADRUPLEX SYSTEM.

THE introduction of the quadruplex system into the Postal Telegraph Department has proved so successful that at the present time nearly a dozen circuits are worked on the principle, and no more difficulty is found in working the apparatus than is experienced in ordinary duplex transmission. This is in a great measure owing to the care which has been exercised in the construction of the instruments. Although the original American patterns have been principally adhered to, several small improvements have been introduced in the apparatus which have proved of greater value than their apparent insignificance might warrant; but it is on small improvements often that the thorough good working of a circuit depends.

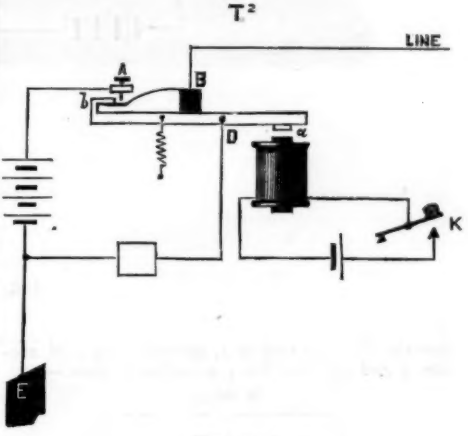


FIG. 125.

In the quadruplex system as at present worked, at each station there are two relays, the one working by change of current strength only and the other by change of direction, so that the two can be worked together if we alter the strength of the currents without affecting their direction, or change their direction without affecting their strength. This is accomplished by combining double current and single current working in such a way that one relay is worked by the one system of currents, and the other relay by the other system of currents. A current is constantly flowing through the line: a change in its direction operates one relay; a change in its strength operates the other relay. The first relay is a simple polarised one, and responds to the reversal of the currents, whatever their strengths; the second relay in the original form of apparatus was a neutral or non-polarised relay, adjusted by an antagonistic spring, so as to fail to respond to the reversed currents unless the latter were of consider-

able strength. Thus the two relays were perfectly independent of each other. They actuated separate sounders, and each was under the control of its own receiving operator, who could thus adjust for himself.

In actual practice difficulties were found in working the neutral relay, especially on long circuits, as the reversal of the current produced breaks or "kicks." This defect, however, Mr. Gerritt Smith remedied in 1876 by introducing the "compound relay," which is now in use. The two sets of apparatus, one at each station, are duplexed in the ordinary manner.

For convenience in working, a table or counter is divided into four sections, and the apparatus is so arranged that operator No. 1 sits at section 1, operator No. 2 at section 2, operator No. 3 at section 3, and operator No. 4 at section 4, thus:—

B SIDE.

Section 4	Section 2
Section 1	Section 3

A SIDE.

The sections 1 and 3 are known as the A side, and the sections 2 and 4 as the B side of the apparatus.

There is the same arrangement at both stations.

Section 1 of one station sends to section 3 of the other, and similarly section 2 sends to section 4.

At each station there are two keys for the ordinary transmission purposes, the one key being a double current one, sending reversals, and the other a single current one, which increases the strength of the reversals sent out by the first key.

As it is a matter of importance that the reversals and increases shall take place sharply and distinctly, the hand-worked keys do not directly manipulate the currents, but merely actuate a "pole reverser" and a "current increaser" by means of local batteries called into action by the keys.

The arrangement of the "current increaser" is shown by fig. 125. It is known as Stearn's duplex transmitter, being generally used in America for duplex working. The line is shown to earth through B and D, but when the armature, *a*, is attracted by the closing of the local circuit (by the depression of key, K), contact between B and E is broken at *b*, while at the same moment contact between A and B is made, and a current from the battery is sent to line. If a second battery be in circuit with the line, then it

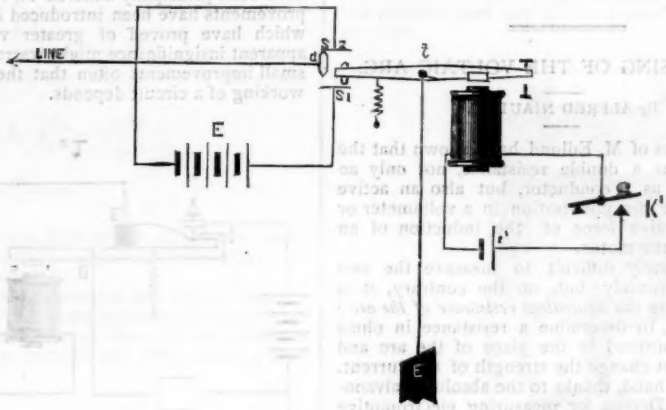


FIG. 129.

is evident that under ordinary conditions a current will continually flow to line from this battery; but if the transmitter be worked, then the battery first referred to will be added to the second battery, and the current flowing to line will consequently be increased.

If wires from the two batteries and the transmitter be passed through a reversing apparatus before passing to line and earth, then this apparatus can reverse the currents, whether they be of their normal strength or be increased.

The general form of the "current increaser" is shown by fig. 126. The two right-hand terminals are connected to the electro-magnet, the left-hand terminal is connected to the contact screw, A, the second terminal to the spring, *b*, and the third terminal to the lever, D.

The general form of the current reverser or "pole changer" is similar to fig. 126, but the arrangement of contacts is of course different, and is shown in general principle by fig. 129.

In the apparatus as shown, a zinc or negative current is going to line through s^2 and *a* from battery E, the copper pole being to earth through s^1 and *t*. When the key, K^1, is depressed, and the local circuit of e^1 completed, the lever, *t*, which is in connection with earth, is brought in contact with s^2, and line, or *a*, with s^1, which causes a

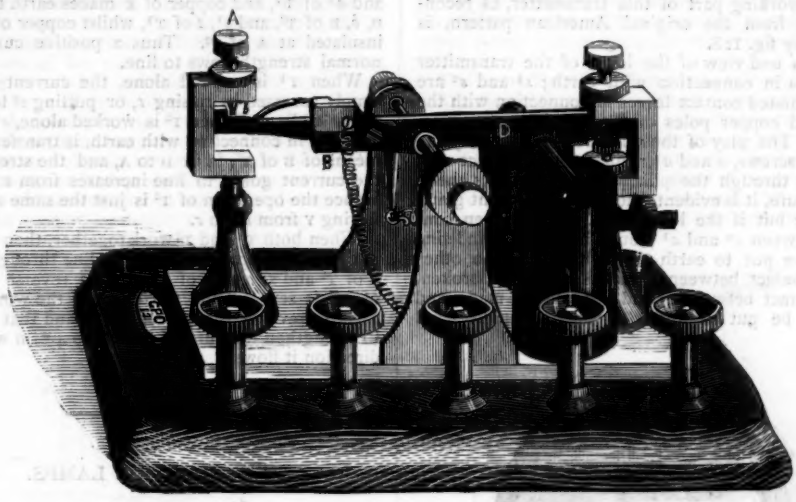


FIG. 126.

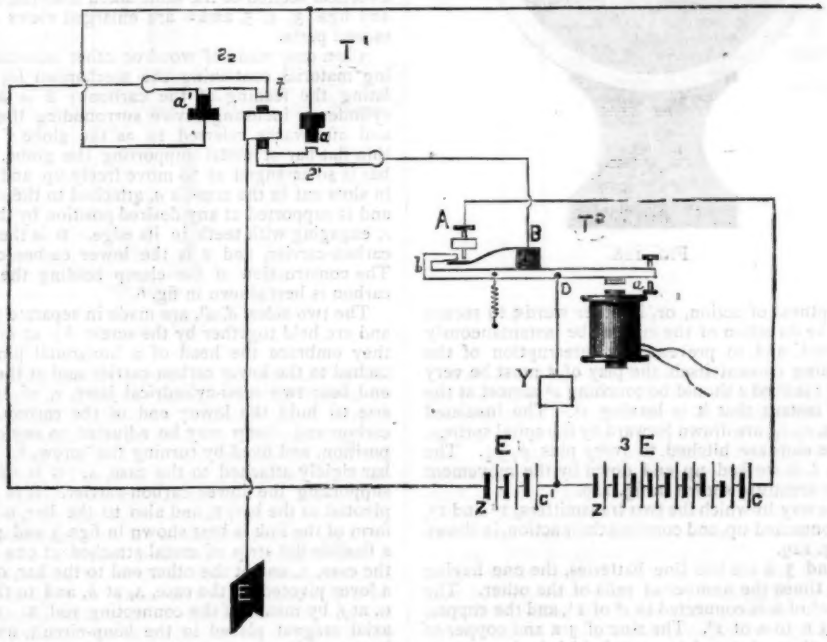


FIG. 127.

reversal or a copper or positive current to flow to line.

The working part of this transmitter, as reconstructed from the original American pattern, is shown by fig. 128.

t is an end view of the lever of the transmitter which is in connection with earth; s^1 and s^2 are two insulated contact levers in connection with the zinc and copper poles of the line battery respectively. The play of these levers is limited by the contact screws, *a* and a^1, which are in contact with the line through the pillar, *d*, that supports them. This figure, it is evident, shows a zinc current going to line; but if the lever, *t*, were raised, then contact between s^2 and a^1 would be broken, and zinc would be put to earth through *t*. On the other hand, contact between *t* and s^1 would be broken, but contact between s^1 and *a* would be made, and copper be put to line. To obtain rapidity and

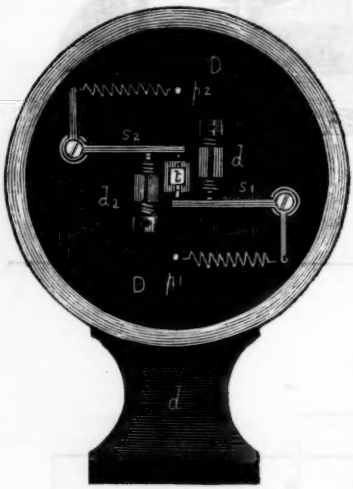


FIG. 128.

promptness of action, or, in other words, to secure that the direction of the current be instantaneously reversed, and to prevent any interruption of the incoming current itself, the play of *t* must be very small: indeed *t* should be touching s^2 almost at the same instant that it is leaving s^1. The insulated levers, s_1, s_2, are drawn forward by the spiral springs, whose ends are hitched to ivory pins, p_1 p_2. The lever, *t*, is worked up and down by the movement of the armature shown in fig. 129.

The way in which the two transmitters, T^1 and T^2, are connected up, and combine their action, is shown by fig. 129.

E and 3 E are the line batteries, the one having three times the number of cells of the other. The zinc, z^1, of E is connected to s^2 of T^1, and the copper, *c*, of 3 E to A of T^2. The zinc of 3 E and copper of E pass through a resistance, Y (which is the same as the resistance of 3 E, so that the total resistance of the circuit may not be altered by the working of the apparatus) to lever D of T^2. When everything is quiet, zinc of E is connected to line through *s* and a^1 of T^1, and copper of E makes earth through D, *b*, B of T^2, and s^1, *t* of T^1, whilst copper of 3 E is insulated at A of T^2. Thus a positive current of normal strength flows to line.

When T^1 is worked alone, the current of E is simply reversed by raising *t*, or putting s^2 to earth, and s^1 to line. When T^2 is worked alone, s^1 of T^1, which is in connection with earth, is transferred, by means of B of T^2, from D to A, and the strength of the current going to line increases from E to 4 E. Hence the operation of T^2 is just the same as transferring Y from c^1 to *c*.

When both T^1 and T^2 work together, then Z of E is put to earth through *t*, and C to line through A and B of T^2 and s^1 and *a* of T^1; and a reverse current of 4 E is sent. Thus the effect of the working of T^1 is to reverse the current of E, and that of T^2 is to strengthen the current from E to 4 E, in whatever direction it flows.

NEW ELECTRIC LAMPS.

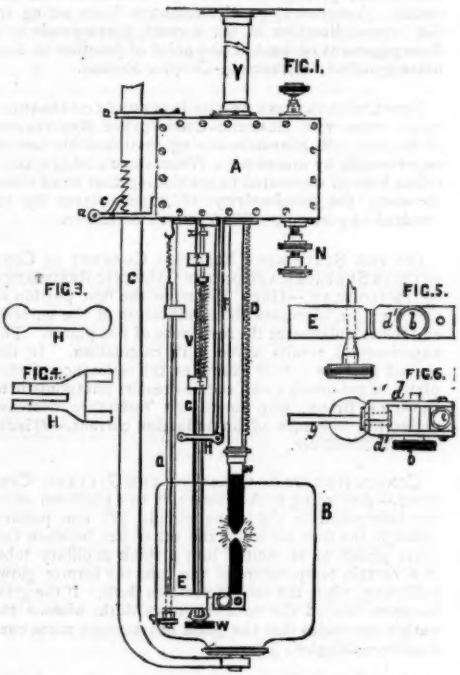
MAXIM'S ARC LAMP.

THIS lamp, the invention of Mr. Hiram Stevens Maxim, of New York, is constructed as follows:—Fig. 1 is a side elevation of the apparatus, fig. 2 is a vertical section of the same taken near the centre, and figs. 3, 4, 5, and 6 are enlarged views of detached parts.

A is a case made of wood or other non-conducting material containing the mechanism for regulating the feeding of the carbons; B is a glass cylinder or inclosing device surrounding the focus, and afterwards referred to as the globe; C is a thin flat bar of metal supporting the globe. This bar is so arranged as to move freely up and down in slots cut in the arms, *a a*, attached to the case, A, and is supported at any desired position by the dog, *c*, engaging with teeth in its edge. D is the upper carbon-carrier, and E is the lower carbon-carrier. The construction of the clamp holding the lower carbon is best shown in fig. 6.

The two sides, *d*, d^1, are made in separate pieces, and are held together by the screw, *b*; at one end they embrace the head of a horizontal pin, *g*, attached to the lower carbon-carrier, and at the other end bear two semi-cylindrical jaws, *e*, of suitable size to hold the lower end of the carbon. The carbon and clamp may be adjusted to any desired position, and fixed by turning the screw, *b*. F is a bar rigidly attached to the case, A. G is a flat bar supporting the lower carbon-carrier. H is a link pivoted to the bar, F, and also to the bar, G. The form of the link is best shown in figs. 3 and 4. I is a flexible flat strip of metal attached at one end to the case, A, and at the other end to the bar, G. J is a lever pivoted to the case, A, at *h*, and to the bar, G, at *j*, by means of the connecting rod, K. L is an axial magnet placed in the lamp-circuit, and M is its core. The upper end of the core passes through and is firmly attached to the head of an inverted cylindrical box, *q*, which fits over the upper head

of the helix, and acts as a dash-pot or controlling chamber for preventing sudden movements of the regulating mechanism. The end of the lever, J, works in a recess, *k*, in the side of the core, M. N is an adjusting screw for limiting the downward movement of the core, M. O is a train of gearing working in a rack, P, on the side of the upper carbon-carrier, and controlling its downward movement. A detent, *m*, upon the lever, J, is so arranged as to come into contact with a star-wheel upon the most rapidly moving shaft of the gearing when the lever is depressed. Q is a rod passing through the lower carbon-carrier, and suspended from the case, A, by means of the spring, R. S is

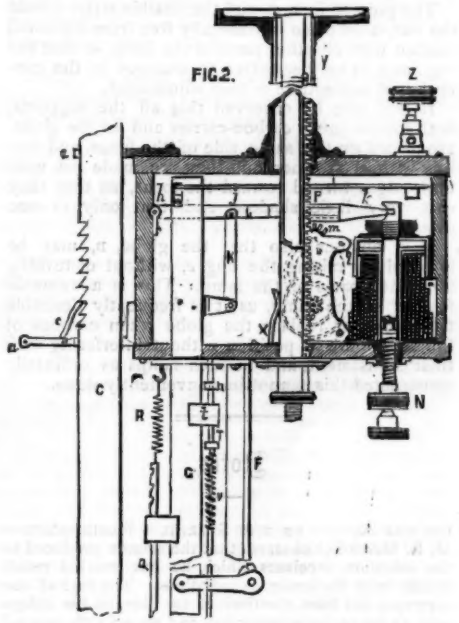


an adjusting nut for regulating the tension of the spring, R. T is a rod attached to the bar, G, by means of the brackets, *l*, *l*¹, through which it has a free movement longitudinally. V is a spiral spring attached to the rod, T, and bearing against the bracket, *l*¹. The rod, T, has a shoulder, *x*, so arranged as to bear against the case, A, when it is thrust up by the spring, V, and at its lower end passes through the lower carbon-carrier and terminates in a forked head, W, so arranged that it may be made to straddle the carbon-carrier, as shown in fig. 5, or when turned a quarter of a revolution, to stand upon its lower surface. In the former position the shoulder, *x*, bears against the lower surface of the case, and in the latter it is drawn down away from it.

The lamp is suspended by means of the tubular support, Y, inclosing the upper carbon-carrier, and the current is admitted to the upper carbon-carrier through a terminal (not shown in the figs.) electrically connected with the spring, X, and to the lower carbon-carrier through the terminal, Z, and spring, I.

The operation of this lamp is as follows :—

The forked head, W, is drawn down and turned around until its legs stand upon the lower surface of the carbon-carrier, E, when the spring, R, raises the bar, G, and lever, J, until the detent, *m*, is raised from the escapement-wheel of the gearing, O. The upper carbon-carrier descends by its own weight until the points of the carbons come into



contact, when the circuit is completed, and a strong current passing excites the coil, L, and draws down its core, M, at the same time depressing the lower carbon and arresting the descent of the upper carbon. When the arc becomes long, the coil, L, becomes too weak to overcome the tension of the spring, R, and the lower carbon is gradually raised and the detent, *m*, is withdrawn, allowing the upper carbon to descend until equilibrium is again restored. The length of the arc may be regulated by adjusting the tension of the spring, R, and the lamp may be stopped at any time by turning the head, W, until it straddles the lower carbon-carrier, E, when the spring, V, obtaining a bearing point against the case, A, at the shoulder, *x*, overcomes the tension of the spring, R, and keeps the lower carbon depressed.

It will be observed that the weight of the upper or positive carbon has no influence upon the operation of the regulating device, which is a material advantage, as the negative electrode is consumed only half as rapidly as the positive one. Where the spring regulating the length of the arc has to support the upper carbon, as in lamps of the ordinary form, it is frequently necessary to re-adjust its tension during the burning of a pencil of considerable length, on account of the diminution of its load, but this difficulty is greatly reduced by applying the adjusting device to the negative carbon. At the same time the arrangement above described secures all the advantages of having the regulating mechanism above the focus, where it does not obstruct the light.

The pivoted link, H, and the flexible strip, I, hold the bar, G, in place horizontally free from frictional contact with all other parts of the lamp, so that the regulator is very sensitive to changes in the current, and susceptible of nice adjustment.

It will also be observed that all the supports, both for the lower carbon-carrier and for the globe, are placed on the same side of the focus, and in a line with each other, and they are made flat with their edges turned toward the focus, so that they cast very little shadow, and that only in one direction.

It is obvious also that the globe, B, may be lowered by raising the dog, *c*, without disturbing the other parts of the lamp. This is a valuable feature of the lamp, as it is frequently desirable to remove or replace the globe when carbons of full length are in position without interfering with their adjustment, and in such lamps as ordinarily constructed this cannot be conveniently done.

Notes.

ON THE ACTION OF THE SELENIUM RADIOPHONE.—M. E. Mercadier observes that the sounds produced in the selenium receivers which he has studied result chiefly from the luminous radiations. The rays of the spectrum act from the limit of the blue, on the indigo side, as far as the extreme red, and even a little beyond the red. The indigo, violet, and ultra-violet rays are without perceptible action in the conditions under which he has experimented. The maximum effect is always produced in the yellow portion of the spectrum. Radiophones with glass tube-receivers containing air, in contact with a smoked surface, give a different result, the action being principally thermic.—*Comptes Rendus.*

Les Mondes proposes to apply the photophone to the study of the *aurora borealis*.

ON THE GALVANIC POLARISATION PRODUCED BY METALLIC DEPOSITS.—D. Macaluso.—The polarisation of copper, employed as negative electrode in a solution of sulphate of zinc, is never null, as Lippmann believes, in cases where the solution contains traces of a salt of copper, and that the deposit of zinc is exceedingly slight and invisible. On the contrary, it has a value which may differ much, and which is so much the greater the smaller the quantity of a copper-salt contained in the solution, and the less the time which has passed from the moment when the polarising current was interrupted.—*Gazzetta Chimica Italiana.*

ON THE ELECTROMOTIVE FORCE OF THE VOLTAIC ARC.—M. F. P. Le Roux.—When an electric flux is established between two conductors of the same nature by means of a gaseous medium, which is commonly the vapour thrown off by their substance, the inequality of temperature of those portions of the conductors which are contiguous to such a medium appears to be a general fact. It seems not less probable that the extremity by which the positive electricity arrives, possesses the higher temperature. This is observed in a remarkable degree in the production of the voltaic arc between two carbons, by means of a current of constant direction. The idea of ascribing to this phenomenon a thermo-electric origin is not novel. According to the application of the principle of the equivalence of heat to electric phenomena, an electromotive force acting in the inverse direction of the current, corresponds to a disengagement of heat at the point of junction of two heterogeneous substances.—*Comptes Rendus.*

NEW OBSERVATIONS ON THE INFLUENCE OF IRRADIATION UPON THE ELECTRO-CONDUCTIVE RESISTANCE OF SILVER.—R. Börnstein having continued his former experiments, by means of a Wheatstone's bridge, considers himself warranted in concluding that irradiation increases the conductivity of silver plates by 1¼ hundredths per cent.—*Wiedemann's Beiblätter.*

ON THE STATIONARY ELECTRIC CURRENT IN CONDUCTIVE SURFACES, AND ON THE GALVANIC RESISTANCE OF PSILOMELAN.—Hugo Meyer, in the first portion of this memoir, discusses the ramification of the current, and the calculation of the resistance of flat plates. The experimental results agree with calculation. In the second part the author examines the resistance of thin plates of psilomelan, and obtains results antagonistic to those of Braun, who found the resistance decrease under the influence of an induction current.—*Wiedemann's Beiblätter.*

CONDUCTIBILITY OF GLASS FOR THE GALVANIC CURRENT.—According to A. Sewarz, if two platinum wires are interposed in the same circuit, the one passing through the free air while the other lies between two glass plates, or is melted into a thick capillary tube, at a certain temperature of the tube the former glows brilliantly, while the second remains dark. If the glass becomes heated the former grows dark, whence the author concludes that the glass has become more conductive.—*Dingler's Journal.*

MAGNETIC ACTION UPON THE FLUORESCENT LIGHT PRODUCED BY THE NEGATIVE DISCHARGE IN AN EXHAUSTED SPACE.—K. Domalip.—If we take a well-exhausted cylindrical tube, with rectilinear electrodes placed in its axis, the fluorescent light formed by the cathodic rays consists, as is well known, of a green cylinder bounded by a circle. This circle undergoes transpositions if a magnet is allowed to act upon the discharge. Domalip shows that these, whether in simple or complicated cases, may be explained by the following hypothesis:—The cathodic rays, emanating from the negative electrode, pass on in a straight direction, and the current moves from the anode to the sides of the cathodic space, and from thence to the negative electrode. The magnet acts upon these currents according to Ampère's rule.—*Wiener Berichte.*

PATENT LAW AMENDMENT BILL.—At a meeting of inventors, patentees, and others, held on the 25th ult.,

Professor Fleming Jenkin in the chair, resolutions were adopted, along with a memorial to the Board of Trade and law officers of the crown, cordially approving of the general features of Mr. Anderson's Patent Law Amendment Bill, and especially of the proposals; first, for provision for the appointment of three paid commissioners to manage the business of the patent offices; second, for providing for the present excessive stamp duties payable on the obtaining of patents; third, deferring the payment of periodical taxes until later periods, and reducing their amounts; fourth, extending the duration of patents to 21 years; and fifth, admitting of subsequent improvements on patented inventions being protected on payment of one half the stamp duties levied on the original patents.—*Building Times.*

EFFECT OF TEMPERATURE UPON THE ELECTRICAL RESISTANCE OF SELENIUM.—Mr. Shelford Bidwell, in the *Philosophical Magazine* for April, gives an account of some experiments made on the above subject. He says:—"The room being 14° centigrade, a selenium cell was immersed in turpentine at 8° C. There was a great and sudden fall in the resistance. The temperature was then gradually raised. In passing from 8° to 24° the resistance steadily increased; from 24° upwards it rapidly diminished. For this cell, therefore, the resistance is greatest at 24° C. Five other cells were afterwards submitted to the same operation, and their resistance was found to be greatest at temperatures of 23°, 14°, 30°, 25°, and 22° respectively."

ELECTRIC TRANSMISSION OF FORCE FOR WORKING CRANES.—According to E. Hospitalier, the use of hydraulic pressure for the transmission of the power required in working cranes in docks, involves a loss which, in some cases, may reach 88 per cent. This evil is entirely obviated, in addition to a great simplification of the entire plant, by means of electric transmission of power, which enables the original steam-power to be fully utilised even when the crane is raising much less than its maximum load. If we reduce the loading of a crane the electro-magnetic machine which drives it will have less work to do, and will revolve more rapidly, and the stronger counter-currents thus produced will react upon the dynamo-electric machine in such a manner that there is a less current produced, and a less demand is made upon the steam-power. The only question is, how the current is to be divided into several unequal branches capable of being varied in strength at any moment.—*La Lumière Electrique.*

M. DUCHEMIN, the inventor of the compass with a circular magnet, now adopted in the French navy, has recently devised, for correcting compasses, a system of magnetic compensators. In place of the straight magnetic bars generally employed he uses magnets of an annular form. If we magnetise a steel ring, it may have two poles at opposite extremities of a given diameter and two neutral lines. Such rings—round, oval, or of any other form, and with or without interruption of continuity—may be utilised for the correction of a compass, by being placed either on the bridge of the vessel or in the binnacle.—*Revue Industrielle.*

DANGEROUS LIGHTNING CONDUCTOR.—A lightning conductor was put up at a temporary railway station at Hanover. The connection led to the platform, and an iron bench was fixed so that any unsuspecting traveller might touch the copper conductor.

GALVANIC GILDING.—M. Rod gives the composition of a bath to be used at temperatures from 50 to 80° C. It consists of 60 parts crystalline phosphate of soda, 10 parts bisulphate of soda, 1 part cyanide of sodium, 2½ parts chloride of gold, and 1,000 distilled water. In order to prepare the bath the water is divided into three portions of 700, 150, and 150 respectively. The phosphate of soda is dissolved in the first lot, the chloride of gold in the second, and the other ingredients in the third. The two first portions are gradually mixed together, and the third is then slowly added. A platinum plate is used as anode.—*Le Monde de la Science.*

THE firm of Biloret and Mora (of the Boulevard Richard Lenoir, Paris), well known for their excellent Leclanché cells and their zinc rods of high purity, have constructed a new revolving contact for their dynamo-electric machines, of the form of a rotatory brush. Besides diminishing the wear and tear of the copper brushes, this arrangement is said to improve the performance of the machine by 25 per cent.—*Zeitschrift Angw. Electricität.*

EDISON has made the "quite new discovery" that large dynamo-electric machines are more advantageous than small ones.—*Ibid.*

ACCORDING to *Les Mondes*, the ship *Oxus* was exposed to a most violent thunderstorm in the Chinese seas. The circular compass of Duchemin perfectly resisted the effects of the lightning, though straight magnetic bars had their polarity modified.

THE same journal states that M. Tommasi has made an improvement in duplex telegraphy, by which the apparatus is protected from the influence of the varying resistance of the line. The arrangements are not described.

M. MAICHE has greatly increased the power of his telephones by modifying the transmitters. He employs "a very ingenious combination of multiple contacts."—*Ibid.*

A FEAT IN NICKEL-PLATING.—The plating company of the Berlopton Lane Works, Stockton-on-Tees, have successfully plated with nickel three large cylinder covers for marine engines, on account of Messrs. Maudslay, Son, and Field, the eminent engineers. The largest cover weighs nearly 1¼ tons, and is 6 ft. 6 in. in diameter. It was plated in the large nickel bath, and polished all over successfully by one of Fenwick's patent portable polishing machines. The same company have also just nickel-plated the whole of the bright parts of Sir James Ramsden's yacht engines, built by the well-known firm, the Barrow Shipbuilding Company (Limited), also, some locomotive domes and safety-valve covers.—*Railway News.*

THE Consolidated Telephone Construction and Maintenance Company (Limited), is the title of a new company, intended to harmonise the hitherto conflicting interests of the United Telephone Company and the Gower-Bell Telephone Company. The capital is to be £300,000, in £1 shares, of which the first issue is to be £200,000.

A COMPANY, entitled the Electric Light and Power Generator Company (Limited), has been formed in London, with a capital of £150,000, in £1 shares. Mr. John Rapieff and Mons. Lontin, the eminent electricians, are associated with this enterprise. We believe the capital was promptly subscribed.

MR. R. S. RHODES, of Chicago, the inventor of the audiphone, has lately visited Paris, where M. Eugene

Pereire is giving his invention a trial in the Pereire Institution for the Deaf and Dumb. Through the influence of the late Sir Charles Reed a similar experiment is being made in connection with the schools of the London School Board. Mr. Rhodes is now on a visit to the Deaf and Dumb Institution at Manchester, where great interest is also taken in the audiphone.

A WRITER in the *North American Review* strongly advocates the purchase of the telegraphic system of the United States by the Government. It appears that powers for that purpose were conferred by an Act of Congress in 1866, the value to be ascertained by the appraisement of five disinterested persons, to be chosen as directed. The present "telegraph monopoly" is represented as injurious to commerce. The ordinary message restricted to ten words costs on an average over 38 cents—equal to 1s. 7d. At the close of last year there were 170,103 miles of line, or between seven and eight times more than in Great Britain, and upwards of 33 millions of messages were sent during the year. By degrees the entire system has, with trifling exceptions, come into the hands of the Western Union Company. The total sum actually expended in plant and stock and other things is estimated as not more than fifteen millions of dollars; but the profits for ten years have averaged over 8½ per cent. on a nominal capital of 41 millions. The company, says the writer not only enjoys a monopoly of the business of sending messages, but also a monopoly of commercial intelligence.

COLONEL PARIS, the head of the Paris fire brigade, has concluded his report on the destruction of the Printemps Establishment by proposing that large warehouses be compelled to light by electricity.—*Nature.*

THE Council of the Royal Society have made their selection of future Fellows for the current session. At the annual meeting of the Society, on June 2, the following candidates will be proposed for election:—Professor W. E. Ayrton, Mr. H. W. Bates, Dr. J. Syer Bristowe, Mr. W. H. M. Christie, Professor G. Dickie, Mr. A. B. Kempe, Professor A. Macalister, Professor H. McLeod, Mr. J. A. Phillips, Mr. W. H. Preece, Mr. B. Samuelson, Mr. B. B. Stoney, Dr. Ramsay H. Traquair, Rev. W. H. Watson, and Dr. C. R. A. Wright.

THE EDISON LIGHT IN NEW YORK.—The Mayor of New York has vetoed the ordinance permitting the Edison Electric Illuminating Company to lay tubes in the streets, on the ground that no adequate provision is made for a suitable return to the city treasury for a valuable privilege.

THE trial trip on the electric railway at Berlin has been successfully inaugurated. It is said that considerable difficulties have been experienced in consequence of the leakage which took place from the conductors in wet weather, which has rendered necessary a rearrangement of the method of insulating the same.

ELECTRIC LIGHT AT BRIGHTON.—In view of the experimental street-lighting by electricity in the City of London, some interest attaches to a report made yesterday to the Brighton Town Council by their surveyor (Mr. Lockwood), relative to the recent lighting by Siemens' system of electricity of a portion of the Marine Parade. Originally four lamps (each of 2,000 candle-power) were used at intervals of about seventy yards, but at this distance the light was more powerful than necessary under any circumstances; but when the distances were increased to 133, 154, and 190 yards, and the lanterns inclosing the lights filled with ground instead of plain glass, there was a marked improvement, the light being softer and more agreeable, yet still powerful enough to throw a distinct shadow at 200 yards. The Madeira Road, which was about 80 feet below the lanterns (running parallel with the parade), the beach, and the foreshore were "brilliantly illuminated" down to low-water mark; and, if similar lighting were employed along the whole of the sea-frontage, the esplanades could be used as well by night as by day. No estimate is given of the relative cost of gas and electricity; but some idea of the respective illuminating powers is furnished by the statement that 20 electric lamps (which, if placed 200 yards apart, would illuminate the whole of the sea-frontage of the town) would render about 140 of the existing gas lamps unnecessary, and thus save about £500. But this comparison is scarcely a fair one, as the gas lamps give a light in no way approaching that afforded by electricity.

AUSTRALIAN TELEGRAPHY.—At the close of 1879 some 31,556 miles of telegraph wire were at work on the Australian Continent, and 40,634 miles with Tasmania and New Zealand added.

THE New York Gold and Stock Company, America, intend to replace their open wires by underground ones on the Brooks' paraffin oil system.

WE are informed that the difficulties which have hitherto prevented the United Telephone Company extending their exchange system over the whole metropolis, owing to the Post Office monopoly, have now been removed. The Post Office has granted a licence to the company to erect telephone exchanges, they paying the Post Office an annual royalty on the subscriptions received.

M. VAN MALDEREN, the constructor of the well-known "Alliance" dynamo machine, died lately in Brussels, at the age of 70.

IN the miscellaneous departments, United Telephone Shares were in considerable demand, on the understanding that the existing disputes with the British Gower-Bell Company have been satisfactorily disposed of. We believe we are correct in saying that a new company will be formed harmonising all interests.

A BILL has been introduced into Parliament for the purpose of authorising the erection of a system of pneumatic clocks in the streets of London.

IT is said that the Telephone Company in Belgium has inaugurated a system by which subscribers leaving word the previous evening may be awakened at any hour in the morning by means of a powerful alarum.

THE offices of the Lancashire and Yorkshire Railway, at Hunt's Bank, Manchester, have been lighted by means of 28 Swan lamps. A single A Gramme generator is used for the purpose.

A NEW company has been established in Belgium under the title of "La Force et l'Electricité." The object of the company is to manufacture electrical apparatus of all kinds.

A MAGNETO-ELECTRIC machine for lighthouse purposes has recently been completed by the inventor, M. de Meritens. The machine will sustain 30 Jablochkoff lights with an expenditure of 15 horse-power.

A NEW alarm thermometer has recently been patented by Herr Finger, of Coblenz. The apparatus consists of a mercurial thermometer, on the top of the mercury column of which a small magnet floats. A magnetic needle, the movement of which closes a contact in circuit with a battery and alarm, is set at any required height close to the tube, and when the magnet on the mercury has risen to that particular height the needle is attracted and the alarum sounded.

M. DAUDIGNY, electrical engineer in Paris, has sent to the Municipal Council a petition asking for authority to establish on the top of the Colonne de Juillet a large electric lamp fed by a magneto-electric machine of fifty horse-power. This enormous light is to be diffused by a large reflector of special construction.—*Nature.*

A MOST successful experiment in theatre illumination was tried on March 30 and 31, at the Athenæum of the Rue des Martyrs, Paris, with the Werdermann incandescent light. The peculiarity of it is that it can be graduated at will for scenic effects, either by introducing resistance coils or varying the velocity of the Gramme machine. These experiments were witnessed by several influential members of the Municipal Council, who on the following morning proposed an inquiry into the propriety of obliging all the theatrical managers to light their halls with electricity.—*Nature.*

THE employment of tricycles for the use of telegraph messengers in New South Wales is being instituted.

THE FARADAY LECTURE.—At the triennial meeting of the Chemical Society, on the 6th inst., held at the London Institution, Professor Helmholtz delivered the Faraday lecture for the present year. A crowded and distinguished audience were assembled. Professor Roscoe, Professor Tyndall, Sir W. Thomson, Sir J. Lubbock, Professor Siemens, were present, amongst many other scientific men. Before the delivery of the lecture, Professor Helmholtz was presented with the Faraday medal for the year. Professor Roscoe, as president of the Chemical Society, said he had the honour to present him with the medal, together with (through the kindness of Mr. Matthey) a replica in palladium. The applause with which their honoured guest had been received assured him that no formal introduction was necessary. He had only to say that Professor Helmholtz, eminent as an anatomist, a physiologist, and a mathematician, was now claimed by them as a chemist. The lecturer then proceeded to trace the modern development of Faraday's conception of electricity, illustrating his lecture with an electrometer and other apparatus. Faraday, he said, amidst all his speculations and conceptions, always kept within the domain of phenomena. His theory was to express in his new conceptions only facts. The researches of Mr. Clarke Maxwell and others who had followed him had tended to show that his fundamental conception of electricity was the only one which was not in actual contradiction to the accepted theory of dynamics, and it promised therefore to receive general acceptance. Specially dealing with the subject of electrolysis, Professor Helmholtz pointed out the possible influences of electricity in chemical changes, and by showing that the electrical conditions of atoms corresponded with the combining conditions, as set forth in the chemical doctrine of quantivalents, opened out a wide field for discussion and investigation. Professor Roscoe, in moving a vote of thanks to the lecturer, made some further reference to Faraday, whose conceptions, he remarked, were entirely in accordance with all the modern developments of electrical science. The vote was seconded by Professor Tyndall; while thanking Professor Helmholtz for his address, he took the opportunity of paying a tribute to the private character as well as to the public achievements of Faraday.

BROOKS' CABLE AT BRUGES.—The following tests of the insulation and electrostatic capacity were made on the 18th March of this year, by Mons. Dumont:—

Temperature, 3° C.

Tested Wires.	Insulation, per Kilometre.	Electrostatic Capacity, per Kilometre.
1	211 megohms.	0,095 microfarad.
2	164 ,,	0,140 ,,
3	185 ,,	0,125 ,,
4	152 ,,	0,133 ,,
5	179 ,,	0,138 ,,
6	173 ,,	0,146 ,,
7	133 ,,	0,135 ,,
8	164 ,,	0,135 ,,
9	158 ,,	0,143 ,,
10	146 ,,	0,130 ,,
11	164 ,,	0,130 ,,
12	133 ,,	0,140 ,,
13	133 ,,	0,135 ,,
14	164 ,,	0,133 ,,
15	133 ,,	0,125 ,,
16	164 ,,	0,140 ,,
17	133 ,,	0,135 ,,
18	185 ,,	0,130 ,,

THE TELEGRAPH CLERKS.—The return moved for by Mr. E. D. Gray, M.P., of the number of telegraph clerks who have resigned since 1872, has been published. The numbers were: in England—males, 1,192; females, 636. Scotland—males, 136; females, 66. Ireland—males, 159; females, 54; total, 2,343. Showing that about one-third of the staff left for more remunerative employment, or about one-half of those who had proved themselves to be efficient in their service. The return does not include deaths or dismissals. In the face of these figures, it is desirable, nay, imperative, that Mr. Fawcett should take the briefest way, consistent with thoroughness, to remedy a state of things which is not compatible with the dignity of a Government department. We have on other occasions protested against the telegraph department being regarded as a dividend paying concern, and it is clear that, although the public should pay a trifle more in taxes, a greater gain would be made by the nation in retaining the best telegraph clerks, and paying for them at equitable rates.

TELEGRAPHING THE RESULT OF THE OXFORD AND CAMBRIDGE BOAT RACE.—The National Associated Press despatch giving the result was transmitted from the point of the finish to the London Agents' office, and filed with the Direct United States Cable Company, who transmitted it to New York in twenty-seven (27) seconds. This perhaps is the quickest time ever made by any cable company, and as such is worthy of note.

IN the litigation between the Post Office and the Edison Telephone Company, the Attorney-General on the 11th inst. applied to two judges of the High Court to vary the decree restraining the company from continuing the business they had been carrying on. The litigation had now come to an end. When once the claim of the Crown to the monopoly was admitted,

they would be ready, in the interests of the public, to grant licences, so that there might be no impediment in the way of the active carrying on of the telephonic communication. The application was granted. A similar application was granted in the case of the Bell Company.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

A CONVERSAZIONE of this Society, on the occasion of Professor Helmholtz's visit to London, was held on the 11th inst. in the Rooms of the University College, Gower Street (kindly lent by the Council of the College). A large number of members and visitors were present, and were received by the President of the Society, Professor Carey Foster, F.R.S., in the Library of the College. A large collection of electrical apparatus and appliances were exhibited by the following gentlemen: R. Anderson, Professors W. E. Ayrton and J. Perry, Shelford Bidwell, M.A., LL.D., E. B. Bright, Latimer-Clark (Past President), Latimer-Clark, Muirhead & Co., James Coxeter, R. E. Crompton, Messrs. Elliott Bros., Professor Carey Foster (President), W. Graves, Professor Kennedy, J. A. Lund, G. Lund, R. S. Newall, W. H. Preece (Past President), Robert Sabine, Messrs. Siemens Bros., the Society of Telegraph Engineers and of Electricians, C. E. Spagnoletti, A. Stroh, C. M. Whipple (Superintendent Kew Observatory). The rooms were lighted by a number of Mr. Swan's incandescent lamps, and the corridors and courtyard by Mr. R. E. Crompton's arc lamps.

PHYSICAL SOCIETY.—MARCH 26th.

Professor FULLER in the Chair.

New member—Mr. LEWIS WRIGHT, author and editor.

DR. JAMES MOSER read a paper on electrostatic induction especially relating to the branching of the induction in the differential inductometer and in the electrophones. The author's experiments bore out the hypothesis of induction as enunciated by Faraday.

Prof. AYRTON suggested the importance of adding guard rings to the small plates of the five plate inductometer or balance, since without this, mathematical calculations could not be accurately applied, and the experimental determination of specific inductive capacity would be doubtful.

Dr. MOSER pointed out that though the theory was not absolutely correct it lay with the experimenter to get results very approximately correct.

Prof. REINOLD, one of the secretaries of the Society, read a paper by himself and Prof. RÜCHERT on the electrical resistance of liquid films, with a revision of Newton's scale of colours. The experiments were in continuation of those published by the authors in 1877. Their object was to determine whether a film thinning under the action of gravity gave any evidence, by a change in its specific resistance, of an approach to a thickness equal to twice the radius of molecular attraction, and also to devise a method of finding the amount of water which might be absorbed by or evaporated from it.

The thickness of the films was determined from their colour by means of two beams reflected from different mirrors on them. Newton's scale of colours was revised by observations on Newton's rings, and partly by more than 2,000 observations on the rings themselves. The thicknesses determined by direct observations on Newton's rings and those in the corrected table rarely differ by 1 per cent., while Newton's scale in parts differs from both by as much as 10 per cent. of the thickness.

The films were formed from a solution of oleate of soda in glycerine, with a little nitrate of potash added to increase their electric conductivity. They were blown in a glass case from which the outer air could be excluded. Precautions were taken to keep the air in contact with the films inside the case at a proper humidity. These consisted in placing discs containing the solution at the bottom of the case, and suspending within it sheets of blotting paper the lower edges of which dipped into the liquid. A hair hygrometer indicated changes in the humidity of the interior. The resistance of the films was measured by piercing them with gold wires, which were connected with the electrodes of a quadrant electrometer. The resistance of the film between the needles was calculated by comparing the deflection caused by the difference of potential of the two wires when a current was passing through the film with that produced by the difference of potential above and below a known resistance placed in the same circuit. The specific resistance of the liquid from which the films were formed was measured by a method identical in principle with the above. The liquid was contained in a glass tube with turned up ends. Platinum wires were cemented into small holes drilled in the straight part of the tube, and their difference of potential compared with that of two points in the same circuit separated by a known resistance. This method has the great advantage of getting rid of any difficulties connected with polarisation. Test experiments on sulphuric acid proved the method to give results agreeing with those of Kohlrausch, who employed alternating currents and Wheatstone's bridge.

The results of the experiments may be summed up as follows:—It is difficult to form a soap film under conditions precluding a slight evaporation or absorption of water, but the more nearly these conditions are attained the more closely does the specific resistance of the film agree with that of the liquid in mass. The films observed under the most favourable conditions obeyed Ohm's law with great accuracy and much better than the others. The films indicate no approach to a thickness equal to the diameter of molecular attraction. A soap film may even in an inclosed space readily lose 23 out of 57·7 volumes of water contained in every 100 volumes of the solution, when special precautions are not taken to maintain the surrounding space in a constant hygrometric condition.

Prof. AYRTON suggested that in measuring the liquids and film the distance between the electrodes should be varied.

Prof. GUTHRIE pointed out that the results of Prof. Reinold and Kohlrausch agreed with his own in showing that the conductivity of liquids obeyed Ohm's law.

APRIL 9.

Professor W. G. ADAMS in the Chair.

Professor HELMHOLTZ was elected an honorary member of the Society, and Dr. JAMES MOSER an ordinary member.

Dr. J. H. GLADSTONE read a note on thermal electrolysis, by himself and Mr. ALFRED TRIBE. The authors found that when sheet silver was plunged into fused silver chloride, or iodide of silver, crystals of silver formed on the sheet. Similarly, copper immersed in fused cuprous chloride, copper crystals deposited on it, and when zinc was placed in melted zinc chloride, or iron in melted ferrous chloride, these two metals crystallised on the plates. They found this to be due not to a difference in the physical condition of the rolled metals, but on the unequal heating of the different parts of the immersed metals. By the contact theory of voltaism, there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed at the same always, there is the possibility of a current being set up and consequent electrolysis of the salt. This view was corroborated by heating the metal unequally, when a crop of crystals appeared in the cooler part of the liquid. Again, two silver rods connected together, were plunged, the one in a hotter, the other in a cooler part of fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver whilst the former was clean. A galvanometer showed a stronger current between the rods the greater the difference of temperature between the parts of the fluid in which they were placed; and transposing the rods reversed this current. These experiments bear on the nature of voltaic action, and form a lecture illustration of the conversion of heat into electricity and chemical force.

Mr. W. H. WALENN stated that he had found when zinc is immersed in an electro-brassing solution, crystals of brass (*i.e.*, zinc and copper) were deposited on it.

Capt. ABNEY exhibited a number of photographic negatives taken by himself and Col. FESTIN by radiation through thin sheets of ebonite. The light from the positive pole of an electric lamp was sent through a thin sheet of ebonite, $\frac{1}{64}$ in. thick, and photographs taken showed the radiation to have a low wave length from 8,000 to 14,000. The carbon points of the lamp could be photographed through the sheet, and Col. FESTIN observed the sun's disc through it.

The ebonite showed a grained structure, and different samples of ebonite gave different results, but all gave some result in course of time at least; old ebonite, like that used in some of Mr. Preece's experiments, scattering the light more than new ebonite. Dr. MOSER exhibited the passage of the rays through the ebonite to the audience by means of a galvanometer. Prof. GUTHRIE observed that Capt. ABNEY had proved light as well as heat traversed the ebonite, and Dr. COFFIN stated that the composition of ebonite apparently the same might vary considerably.

Prof. HELMHOLTZ addressed the meeting on the localisation of objects by the eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer ones where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as, for instance, binocular vision. This is shown by Dove's pseudoscope, and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects as the eye is moved from side to side, or to and fro, or up and down, which may be called the parallax of motion, is also a strong factor in estimating distance. The author concludes from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distinct objects produce the stereoscopic effect. Recent observations of his show that the incongruity between the degree of convergence and the parallax of motion is perceived with great accuracy. Dr. STONE remarked that a person suddenly blinded in one eye acquires a new judgment of distance by moving the head; and Mr. LEWIS WRIGHT pointed out that santonin, which changes the sense of colour, also appears to change the sense of distance.

New Patents—1881.

1358. "Electric lamps." R. HARRISON and C. BLAGBURN. Dated March 26.

1384. "Electric lighting apparatus." W. R. LAKE. (Communicated by A. G. Holcombe.) Dated March 29.

1393. "Electric drills." J. W. THOMSON. Dated March 29.

1395. "Electrical apparatus for the transmission or reproduction of sound." W. R. LAKE. (Communicated by A. E. Dolbear.) *Complete*. Dated March 29.

1412. "Manufacture of carbon for incandescent electric lamps." J. SCOTT and W. H. A. RESTER. Dated March 31.

1422. "Improvements relating to the production of electric light." W. CROOKES. Dated March 31.

1442. "Electric batteries." F. R. DE WOLSKI. Dated April 1.

1447. "Dynamo-electric, or magneto-electric machines." C. W. SIEMENS. (Communicated by Siemens and Halske.) Dated April 1.

1453. "Interlocking of railway telegraphic block instruments, points and signals, and apparatus for that purpose." C. HODGSON. Dated April 2.

1474. "A new or improved apparatus for laying underground telegraphic or telephonic conductors." J. C. MEWBURN. (Communicated by J. Bourdin and Gen. S. J. de Maltzoff.) Dated April 5.

1526. "Improvements in electric lamps, and in electro-magnets applicable to these and to other electrical purposes." Dated April 7.

1536. "Electric lighting apparatus." J. L. A. DUPONT-AUBERVILLE. (Communicated by F. Delaye.) Dated April 8.

1543. "Electric lamps." S. G. L. FOX. Dated April 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

3025. "Electric lighting." PETER JENSEN. (A communication from abroad by Michael Avenarius, of

Kiev, Russia). Dated 22nd July. 6d. In this invention each of the conducting wires of the burners is connected to the corresponding electrode of a voltameter.

3041. "Producing and directing electric currents, &c." CHARLES GODFREY GUMPEL. Dated 24th July. 2d. Relates to apparatus for producing, directing, and intensifying electric currents and applying them for communicating power to a distance, and controlling such power. Instead of winding the wires of the inductors of the dynamo machine in the usual way, that is to say, with the secondary coil superposed on the primary coil, these coils are wound together, that is to say, the primary wire of considerable sectional area along with a number of secondary wires of smaller area, thus obtaining a juxtaposition throughout the coil of the secondary and primary wires, and bringing most of the secondary coils nearer to the core. (*Provisional only.*)

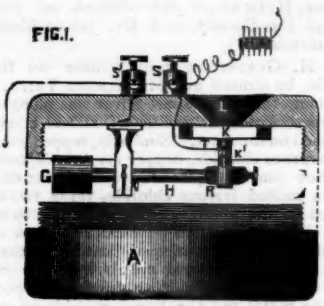
3219. "Obviating effects of extraneous electrical disturbances on telephonic lines." JOHN IMRAY. (A communication from abroad by Doctor Cornelius Herz, of Paris.) Dated 6th August. 2d. Relates to means of obviating the effects of disturbances on telephonic lines, for which purpose the line wire instead of being led directly to earth from the receiving instrument is made to terminate in a number of fine points extended over a considerable area, and another set of such points in close proximity to the former set communicate by a wire to earth. Thus electricity in passing from the one part of the line to the other forms a brush, or passes by a diffused and silent flow from the one set of points to the other. The space between the two sets of points may be filled with a medium, such as alcohol, oil, or hydrocarbons, or with gas other than air, or air or gas more or less rarefied. (*Provisional only.*) (*See* TELEGRAPHIC JOURNAL, 1st March.)

3310. "Insulating telegraph conductors," &c. EDWIN THOMAS TRUMAN. Dated 14th August. 4d. Relates to improvements in insulating telegraph conductors, and in the mode of and machinery for manufacturing telegraph conductors, the improved machinery being also applicable for other purposes.

3424. "Electric conductors," &c. GEORGE BARKER. (A communication from abroad by William W. Jacques, of Boston, America.) Dated 24th August. 4d. The object of this invention is to provide an insulating coating for telegraph wires and other electric conductors which shall have a high insulating power and at the same time be tough, pliable, and elastic under any conditions of temperature or weather to which it would naturally be exposed, which shall be entirely impermeable to water, gases, and moisture, and not affected by atmospheric influences nor liable to change with time, and, finally, which shall be much cheaper than substances usually employed for the same purpose. The wire is covered with rubber, whose pores are thoroughly impregnated by a peculiar process with a mixture of about equal parts of Venice turpentine and beeswax, and then coating this impregnated rubber with more of the preserving compound, sulphur, and various dilutants, by continued working on warm rolls.

3420. "Apparatus for transmitting sounds." FREDERICK ROBERT VON WREDEN, M.D. Dated 23rd August. 6d. Relates to an improved microphonic transmitter. T is a very thin (from 0·0002 to 0·003 of an inch thick) and tightly stretched membrane, T (figs. 1 and 2). An electrically conducting piece, K, of carbon is fixed on the membrane, T, and communicates by means of a fine wire, *a*, with a terminal, *s*. H is a contact regulator. On one end of this regulator is fixed a thick ring, R, in which is fixed a piece of carbon, K^1. The piece, K^1, is in direct contact with the cylindrical piece, K, fixed on the membrane, and through the

FIG.1.



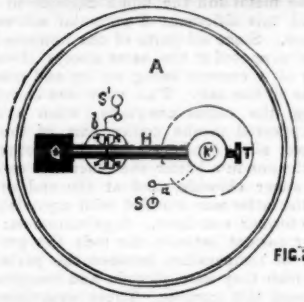


FIG.2.

metallic contact regulator, H, and a fine copper wire, *b*, is in connection with the terminal, s_1. The other end of the contact regulator is provided with a fine, accurately cut screw thread, on which a counterweight, G, can be moved to adjust the degree of contact or pressure between the two pieces of carbon, K, K^1.

3496. "Apparatus for obtaining electricity." CHAS. WEIGHTMAN HARRISON. Dated 28th August. 2d. Relates to improvements in apparatus for obtaining electricity. (*Provisional only.*)

3509. "Electric lamps." JOHN HOPKINSON. Dated 30th August. 2d. Each carbon is carried from the piston of a hydraulic cylinder. Each cylinder is either so arranged that when fluid is allowed to flow out from that cylinder the carbon it carries advances. The passage of fluid into a cylinder from a cylinder, or from one cylinder to the other, is controlled by a valve, which is opened or closed by an electro-magnet. (*Provisional only.*)

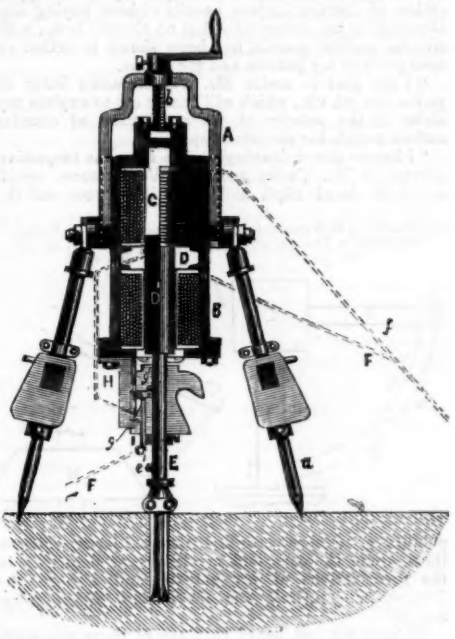
4850. "Switches and apparatus for telephone lines." SYDNEY PITT. (A communication from abroad by Charles Darwin Haskins, of New York.) Dated 23rd November. 6d. Relates to electric calls for use on telephone circuits. Its object is to enable signals to be exchanged between a central office and any station on a given circuit without operating the signal or call bell of any other station on the same circuit, and to provide a means by which persons at other stations will be prevented from interrupting or overhearing a message which is being sent by a person using a telephone at another station on the same circuit, and to supply a method by which the operator at the central office of a telephone exchange will be enabled to set the different instruments at a common starting point.

4866. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by H. Maxim, of Brooklyn, America.) Dated 23rd November. 6d. Relates to the electric lamp described on page 144.

5091. "Electric telegraphy." H. J. HADDAN. (A communication from abroad by Samuel Latham Mitchell Barlow, of New York, Assignee of the Inventor, Dr. Orazio Lugo, of the same place.) Dated 7th December. 6d. The object of this invention is to produce intelligible signals in a long telegraphic circuit with great distinctness by means of secondary induced currents or pulsations of high electromotive force or intensity, which are generated by means of a battery or batteries of comparatively small power through the medium of induction coils. This is effected by putting a telegraphic key, which sends reversed currents from batteries connected to the front and back stops, in circuit with the primary wire of an induction coil; the secondary currents from the secondary coil pass out to line, and at the receiving station pass through the primary of an induction coil which has a telephone in circuit with the secondary wire. The telephone is then read from as in an ordinary sounder.

5092. "Magneto speaking telephony." H. J. HADDAN. (A communication from abroad by Samuel Latham Mitchell Barlow, of New York, assignee of the inventor, Franceso Rosetti, of Padua, Italy.) Dated 7th December. 6d. At the sending and transmitting stations Bell telephones are connected to the primary wires of induction coils, and the secondaries of the latter are connected to line.

5152. "Electric drills." SYDNEY PITT. (A communication from abroad by Charles E. Ball, of Philadelphia, United States of America.) Dated 9th December, 6d. Relates to drills of the class reciprocated by electro magnetism. Its object is to secure a simple, efficient, and durable machine. A is a frame or yoke mounted upon a tripod, the legs, *a*, of which are variable in length so as to adjust the drilling tool properly relatively to the substance to be operated upon. A stock or cylinder, B, slides freely endwise in the frame, its movement being controlled by an adjusting screw, *b*. Coils or helices, C, D, of insulated wire wound in a way usual with electro-magnets are secured in the stock, B, end to end in the same axial plane, but with a space between them. An ordinary soft iron core, D^1, common to both these helices has the capacity of sliding freely endwise axially therethrough, the core it will be observed being about one-third longer than either coil, so as to always leave it within their magnetic field. The upper end of the cylinder, D, terminates in a small chamber in which the core, D^1, plays on its back stroke; the confined air in this chamber is thus compressed at each back stroke, and acts as a buffer to prevent shocks or jars. A tool-stock or drill-holder, E, constituting a prolongation of this core carries the drilling-tool in usual well-known ways. The conductor from a dynamo or magneto-electric machine or generator is divided, each branch being connected with its respective coil, so that the circuit may pass alternately through each one as it is shunted by the action of the rheotome or circuit-changer hereinafter described. One terminal of the coil, C, leads to contact, *g*, and a terminal of the coil, D, likewise connects with another contact, g^1, both of said contacts being insulated from each other, but secured to the same pendant or bracket, H, of the stock, B. The return wire, F^1, to the generator is secured to a T-shaped bar, I, located between the drill-stock, E, and pendant, H, above mentioned. With the parts in the position shown in the figure, one coil, C, is in circuit, while the other one, D, is inactive. The operative force of the coil, C, draws the core, D^1, into it and retracts the drill, at the same time moving the bar, I, out of contact with the contact, *g*, and into contact with the contact, g^1, this bar being moved at the proper time by the tappets or wipers, *e*, e^1, on the drill-stock, E. As the core, D^1,



reaches the limit of its back stroke the bar, I, comes in contact with the contact, g^1, thus changing the current from the back coil, C, to the front one, D, causing the core to be drawn forcibly into said coil, thus producing the necessary stroke of the drill. When the forward stroke of the drill is completed, the stud, *e*, strikes the plate, I, and forces it against the contact, *g*, thus again throwing the coil, C, into circuit, and the coil, D, out of circuit, and retracting the drill. These operations being repeated at every stroke of the drill produce a very rapid and effective reciprocation.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I beg to forward you a copy of a letter I have sent to the editor of *La Lumière Electrique*, which has reference to a letter to which you kindly gave publicity in your columns some time ago.

Knowing the unbiassed tendency of your Journal to aid all workers in science, you will, I am sure, by giving publicity to this letter, aid me in maintaining my claim to the priority of the application of circular carbon pencils for electric lamps.

I am, dear Sir, yours very truly,
CHAS. F. HEINRICHS.

25, Guildford Street, Russell Square, W.C.
London, March 19, 1881.

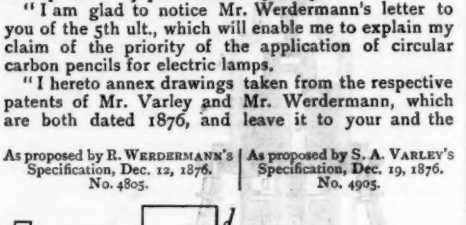
To the Editor of LA LUMIÈRE ELECTRIQUE, *Paris.*

"SIR,—I regret not having noticed, until a few days ago, your answer to my letter in your first number of this year, of the 11th December last year, in which you credit Mr. R. S. Varley with the priority of the application of circular carbon pencils without paying any attention to my statement—that no electric lamp, with circular carbon pencils, has been shown in action or used prior to my patents and my lamps.

"I am glad to notice Mr. Werdermann's letter to you of the 5th ult., which will enable me to explain my claim of the priority of the application of circular carbon pencils for electric lamps.

"I hereto annex drawings taken from the respective patents of Mr. Varley and Mr. Werdermann, which are both dated 1876, and leave it to your and the

As proposed by R. WERDERMANN'S Specification, Dec. 12, 1876. No. 4805.



As proposed by S. A. VARLEY'S Specification, Dec. 19, 1876. No. 4905.

public's good sense to find the similarity between these crude sketches and my lamps, as described in the specifications of my patents, and also in the *Telegraphic Journal*, *The Electrician*, *Engineering*, &c., &c.

"I have not yet heard that any of those proposals have been made or have been in action, and I do not see how they could have been put in action *without adding further invention*. It is evident that the man who proposes to find the North Pole cannot claim any credit from the man who actually finds the North Pole. Thus, Mr. Varley and Mr. Werdermann having *only proposed* to use a rod of carbon forming a portion of a circle (Mr. Varley does not mention at all in his specification that the carbon rod forms a portion of a circle, nor that it is meant to be a curved carbon), cannot have any claim on the invention of my lamps, in which I use two semi-circular or two nearly complete circles of carbon, and to my best knowledge none of the gentlemen have ever put forth such a claim. In his letter of the 5th ult., Mr. Werdermann admits that he has *only proposed the use of carbon rods forming a portion of a circle*, and consequently, he can have only such claim to the actual application of circular carbons pencils as the man who *only proposed* to find the North Pole. The mere idea of using circular carbon pencils does not make the invention, although the mere idea may have been registered in a patent.

"Many gentlemen have told me that they also have had the idea of using circular carbon pencils (that we always hear after an invention has been accomplished, as the large class of would-be inventors cannot distinguish the accomplished invention from the mere proposal). Knowing that I address in you gentlemen of literary and scientific standing, I beg to draw your attention to the three following manners by which alone priority of invention can be proved :—

"Firstly, that the invention has been fully described *in all its details* in the specification of a patent.

"Secondly, that the invention has been shown in operation before the public.

"Thirdly, that the entire plan and features of the invention have been laid before a scientific body.

"As none of the gentlemen have complied with any of these terms, but as I have complied with all of these terms, I hope now that you will credit me with the priority of the application of circular carbon pencils.

"I should never have thought of contesting this question if you had not stated, firstly, that I have re-invented M. Dubos' regulator; and I shall now show that your statement is entirely erroneous, but *that it is possible* that M. Dubos has adopted my plan of using circular carbons.

"In June, 1878, M. Dubos applied for a patent in England for an electric lamp with *straight* carbons, of which Colonel Bolton, in his paper, 'Some Historical Notes on the Electric Light,' read before the Institution of Telegraph Engineers, says as follows :—

"'1878. DUBOS. 2,401. "Improvements in apparatus for producing electric lights." (*Provisional protection only.*) Patents balancing two forces, one produced by a spring weight, &c., and the other by electro-magnetism for keeping the (straight) carbons in the proper positions.'

"This is practically patenting an electric lamp such, as for example, Staite patented in 1847, thirty-one years before.

"I applied on 13th November, 1878, for an English patent, in which I described and patented the application of circular carbon pencils in the same manner as I continue to employ them, and a few days later I myself compressed the first circular carbons ever made to my knowledge, and which were baked (obligingly) at the Battersea Crucible and Plumbago Co.'s Works. Two months later I burnt the same carbons in a rough model lamp made according to my invention.

"Already, in July, 1878, I had asked a large firm to assist me in making my lamps.

"M. Dubos could not have had the idea of employ-semi-circular carbons in June, 1878, as he would have noticed it in the specification of his patent before-mentioned. On 20th January, 1879 (two months after I had applied for my patent in England, after I had actually made circular carbons, and after workmen had commenced making my lamps), M. Dubos applied, firstly, in Germany for a patent, in which he again patents the mechanism mentioned before by Colonel Bolton, and only adds circular carbons to them.

"As regards the mechanism I may state that it will never answer, as no allowance has been made for the feed of the carbons in proportion to their consumption.

"From the before-going facts it will be seen to be impossible that I could have re-invented M. Dubos' regulator, which is as old as 1847, while my regulating mechanism is original and successful.

"Hoping that, in justice to my invention, you will kindly allow this explanation a space in your next issue

"I beg to remain, your obedient servant,

"CHAS. F. HEINRICHS.

"Guildford Street, Russell Square,
"London, March 17, 1881."

W. FOWLER.—The illustrations of the "Duplex and Single Switch," given in our issue for March 15th, pages 100 and 101, are quite right, but the lettering of the same (as you point out) is incorrect, in so far that the letters do not correspond with those given in the old form of switch. The words on page 100, "(which correspond to those in the old form of switch)," should be cancelled. We are obliged to you for pointing out the error.

City Notes.

Old Broad Street, April 11, 1881.

THE EASTERN EXTENSION TELEGRAPH COMPANY (LIMITED).—The fifteenth ordinary general meeting of the Eastern Extension, Australasia, and China Telegraph Company (Limited), was held on April 6th, 1881, at the Cannon Street Hotel; Mr. J. Pender, M.P., presided. The report of the directors, which referred to the half-year ending the 31st of December, 1880, stated that the gross receipts, including Government subsidies, had amounted during the half-year to £193,435 9s. 6d., against £165,930 11s. 2d. for the corresponding period of 1879, showing an increase of £27,504 18s. 4d., of which £21,133 6s. 8d. was the amount received from the Australian and Manila Governments on account of subsidies. The working and other expenses, including a sum of £22,932 0s. 5d. for cost of repair of cables and expenses of ships, together with income tax, would absorb £57,592 1s. 2d. against £57,451 for the corresponding half-year, leaving a balance of £135,843 8s. 4d. From this was deducted £42,350 for interest on debentures and contribution to sinking funds for redemption of the Manila and Australian Government Subsidy Debentures, leaving £93,493 8s. 4d. as the net profit for the half-year, which, with £35,610 10s. 5d. brought forward, made a total of £129,103 18s. 9d. to be dealt with. One interim dividend of 1½ per cent., amounting to £24,968 15s., had been paid during the half-year, and it was now proposed to distribute another of a like amount, together with a bonus of 1s. per share, payable on the 14th April, which, with the two interim dividends and bonus paid for the first half-year, would make a total distribution of 6 per cent. for the year 1880. The balance, amounting to £69,178 18s. 9d., had been carried to the reserve fund, which now stood at £217,268 1s. The only important interruption during the six months occurred on the Java-Australian section in October last, when the cable was broken down for 17 days; the receipts, however, during this period were not affected, as the traffic was transmitted by the alternative line. There were, however, numerous small repairs which required the services of the Company's maintenance ships during the greater portion of the half-year. All the Company's cables were in good working order. In accordance with the articles of association, Sir Thomas Fairbairn, Bart., the Right Hon. Viscount Monck, and the Right Hon. W. N. Massey, M.P., retired by rotation, and offered themselves for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Quilter, Ball, and Co., offered themselves for re-election. The chairman, who moved the adoption of the report, said that during the past year the working expenses had decreased, as compared with the previous year, by £5,431, although extra works had been carried out. All the cables were in good order, but £40,000 had had to be spent in the course of the year in repairs. One of the Company's ships had been at sea 142 days and another 144 days, but all the pieces of cable picked up were replaced by the most improved kind of cable which could be secured. He hoped and believed that, with the improvement of general trade, telegraph business would also improve. Mr. Massey, M.P., seconded the resolution. The chairman, in answer to questions, said he thought the sum of £200,000 as a reserve fund, with a capital of £3,000,000, was not the full amount which they should reach. The directors for the first time had added 1 per cent. to the dividend, but they felt that before going further in that direction the reserve should be still further increased. For the purpose of repairs the Company had determined to use its own ships, for by hiring vessels the expense must be much greater than the Company need expend. Amalgamation had been carried as far as possible with other companies, having regard to the interests of the shareholders. The loss by any further extension of amalgamation at present must cause loss to everybody concerned by the increased expenditure which would be involved. The report and accounts having been adopted, the retiring directors and auditors were re-elected. The proceedings closed with a vote of thanks to the chairman and directors.

GREAT NORTHERN TELEGRAPH COMPANY.—The balance sheet of this Company, for the year 1880, shows that the receipts for this period amounted, with the amount brought forward of £16,242 7s. 4d., to £238,763 4s. 9d., or with interest and sundries added, to a gross total of £260,107 1s. 10d. The expenses for the same period were £67,775 8s. These, with interim dividends paid on 150,000 shares at 5 per cent., £75,000, allow of an addition to the reserve and renewal fund of £55,555 11s. 1d.; an addition to pension fund of the staff, £525, 17s. 10d.; remuneration to the board of directors, £1,500; an extra dividend of 5s. on 150,000 shares, £37,500; and to a carrying forward of balance of £22,250 4s. 11d. The reserve and renewal fund, with the proposed addition, will amount to £180,425 4s. 10d.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).—At the ordinary general meeting of this Company, held on the 31st ultimo, the chairman (Mr. Etlinger), in moving the adoption of the report (see TELEGRAPHIC JOURNAL, previous issue), and after commenting on the various paragraphs contained therein, said:—The only word of interest which he could add would be to tell them how the new half-year had gone so far. In January, February, and March, up to yesterday, and allowing for to-day, the receipts had been £4,875. If the next three months were the same, of course there would be £5,008 more to add, or nearly £10,000. It was right to say that in February the Eastern cable broke down, and they made a little extra profit; but taking this into consideration, and allowing that for April, May, and June, they would make as much as the average they had made in January and March (leaving out February), in that case the receipts for the half-year would amount to £9,375, which, after paying the preference dividend, would leave a surplus of £4,000. How this would be divided it would not be for him to speak about. The shareholders could very well calculate it. One per cent. on the ordinary shares required £582, consequently anybody who would take the receipts as published in the newspapers, and deduct their expenses at the rate of £2,100 for the half-year, could see how they stood. The expenditure had been slightly increased, as, of course, it would naturally be when more forms, stationery, &c., were required. The motion having been seconded, was carried unanimously. The chairman next moved "that the 10 per cent. dividend on the preference shares for the half-year ending 31st Dec., 1880, together with the arrears of 10s. per share due thereon, making together 20s. for the preference shares, be and is hereby declared, less income-tax." This being seconded was agreed to. The retiring directors and auditor were then re-elected. Mr. Matthew Gray said that the cable was originally laid between England and Bilbao, and had broken almost at once in consequence of a long stretch of deep water. The Barcelona cable had never altered in the least, and never required the outlay of one penny upon it. It was lying on a bed of sand all the way, and none of them would live to see it break. The meeting then terminated with the usual votes of thanks.

THE GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).—The report of the directors to be submitted to the meeting on the 12th inst. contains the accounts and balance-sheet for the eight months ending 31st December, 1880, including in the accounts the coupon to that date receivable from the German Union Company of Berlin. The accounts will in future be made up to the 31st December, instead of the 1st May as heretofore, so as to cause no delay in the distribution of the dividends receivable from Berlin. The total receipts during the eight months amount to £14,486 12s. 7d., which, with a balance of £51 1s. 5d. carried forward from last account, make a total of £14,537 14s. The working expenses for the same period amount to £352 1s. 1d., leaving a balance of £14,185 12s. 11d. Out of this amount an interim dividend of 5s. 9d. per share was distributed on the 21st January last, and the directors now beg to recommend the payment of a further dividend of 8s. 3d. per share, making a total distribution for the year of 14s. per share, free of income-tax, or at the rate of £7 per centum per annum. The directors have also written off £130 from the expenses of formation of the Company, thereby extinguishing that item, and leaving a balance of £139 12s. 11d. to be carried over to the next account. The Company's cable and land lines remain in good order and condition. The total receipts from all sources of traffic show a very marked increase. The total traffic between Germany and Great Britain has nearly doubled since the year 1874, and this satisfactory result is attributable in a great measure to the introduction of the single word tariff in 1878. The traffic sent by the various telegraphic administrations over the Company's lines has almost quadrupled during the same period.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).—After placing £37,500 to the renewal fund, it is proposed to declare an interim dividend for the quarter ending 31st March of 1 per cent. on the ordinary stock, and 2 per cent. on the preferred stock.

GLOBE Telegraph and Trust announce an interim dividend for the quarter ending April 18 of 3s. per share on the preference shares, being at the rate of 6 per cent., and 2s. 6d. per share on the ordinary shares, being, with previous payments, at the rate of 4 per cent.

WESTERN UNION TELEGRAPH.—Mr. Hatch has begun a new suit in the Superior Court, and has obtained a temporary injunction against the consolidation of the various companies. The arbitrators appointed to value the plant of the American Union Telegraph Company awarded the Central Construction Company 10,000,000 dols. in stock and 5,000,000 dols. in bonds. About one-half of this was paid previous to the consolidation. Subsequently, the Western Union Company issued its new stock for the balance, and the Central Construction Company divided it up among it stockholders, who are identical with the principal stockholders of the American Union Company.

INDO-EUROPEAN TELEGRAPH COMPANY (LIMITED).—The dividend for the six months ending December 31st will be 17s. 6d. per share, making 6 per cent. for the year, and a bonus of 10s. per share, and placing £7,500 to the reserve fund.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58¼-58¾; Ditto, Preferred, 87-88; Ditto, Deferred, 30¼-30¾; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10-10½; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 14-15; Direct United States Cable, Limited, 1877, 11⅛-11⅜; Scrip of Debentures, 103-105; Eastern, Limited, 9⅞-10; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 102-104; Eastern, 5 per cent., repayable Aug., 1899, 102-105; Eastern Extension, Australasian and China, Limited, 10⅞-10¾; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 11⅛-11¾; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12⅛-12⅜; Great Northern, 12⅛-12½; 5 per cent. Debentures, 103-106; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 6¼-6½; Mediterranean Extension, Limited, 2¼-2⅜; Mediterranean Extension, 8 per cent. Preference, 9⅞-10¼; Reuter's Limited, 10¼-11¼; Submarine, 270-290; Submarine Scrip, 2⅛-2¼; Submarine Cables Trust, 100-103; United Telephone Company, ——; West Coast of America, Limited, 4¾-5¼; West India and Panama, Limited, 2⅛-2⅜; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8½-8¾; Ditto, 6 per cent. Debentures "A," 104-108; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 103-107; Telegraph Construction and Maintenance, Limited, 31½-32; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3¾-4; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 103-106.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		FEB.	MARCH.	REMARKS.
		£	£	
Anglo-American...	1881	49,180	51,540	
	1880	*40,530*	*40,290*	
Brazilian S'marine	1881	15,104	15,762	
	1880	*15,517*	*13,279*	
Cie. Française ...	1881	...	...	Not published.
	1880	..	..	
Cuba Submarine...	1881	2,900	3,100	Jan. estimated at £2,800, realised £2,527.
	1880	*3,140*	*3,588*	
Direct Spanish ...	1881	1,876	1,492	
	1880	..	..	
Direct U. States...	1881	16,390	17,180	
	1880	..	*13,430*	
Eastern	1881	46,463	51,206	
	1880	*44,691*	*43,374*	
Eastern Extension	1881	28,021	29,661	
	1880	*25,190*	*26,425*	
Great Northern ...	1881	16,880	18,520	
	1880	*15,160*	*16,440*	
Indo-European ...	1881	...	...	Not published.
	1880	..	..	
Submarine	1881	...	...	Publication temporarily suspended.
	1880	..	..	
W. Coast America	1881	...	...	
	1880	*1,300*	*1,775*	
West. & Brazilian	1881	10,169	10,797	
	1880	*9,227*	*9,908*	
West India	1881	4,320	...	
	1880	*5,488*	*6,075*	